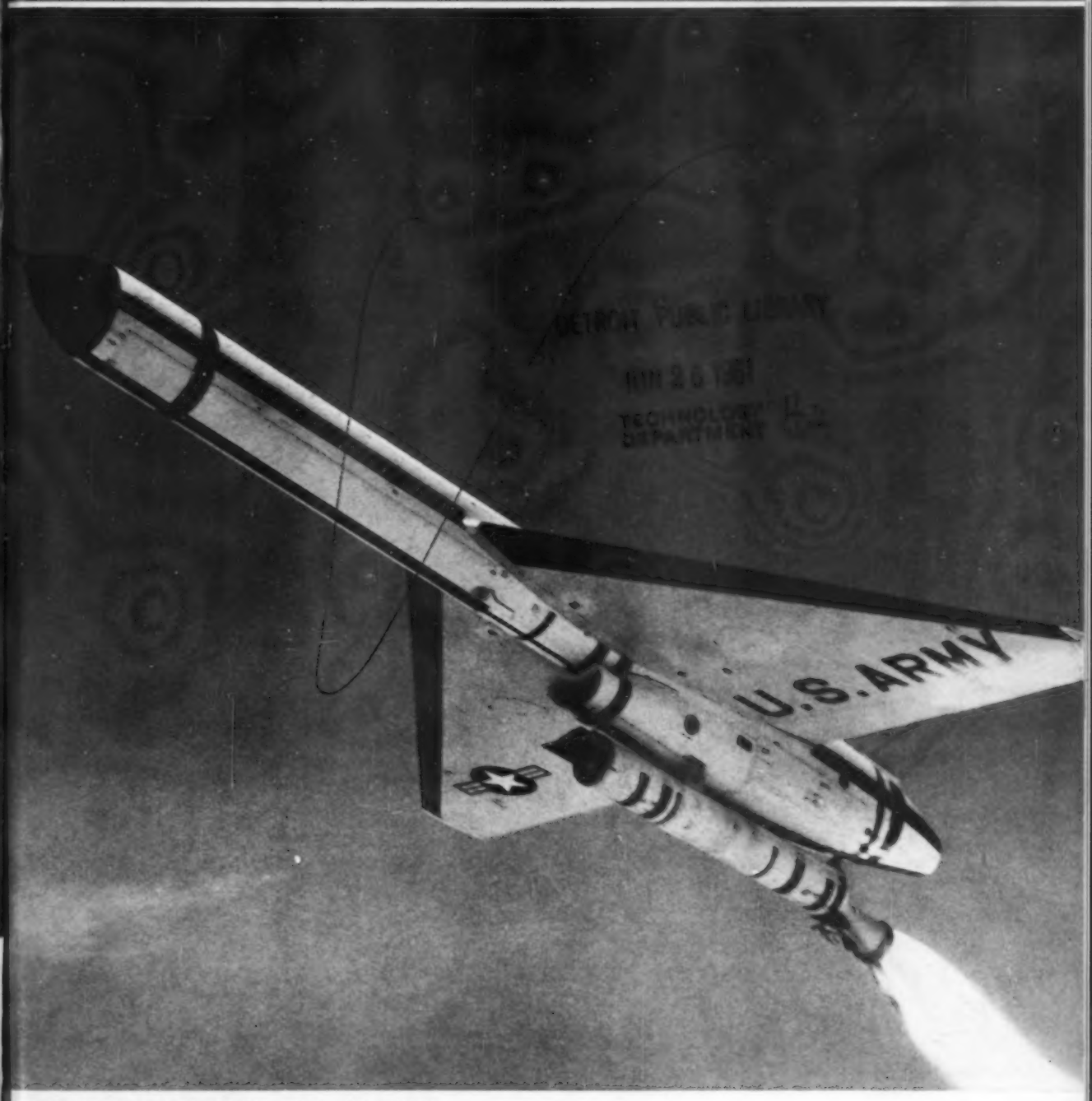
JUNE 26, 1961

missiles and rockets

THE MISSILE/SPACE WEEKLY



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TECHNOLOGY DEPARTMENT

Fairchild's SD-5—Springboard to Big R&D

First Details of S-48 'Topside Sounder' . . . .

DOD Plans Major Changes in Contracting .

Curtiss-Wright's Motor Case Know-how . . .

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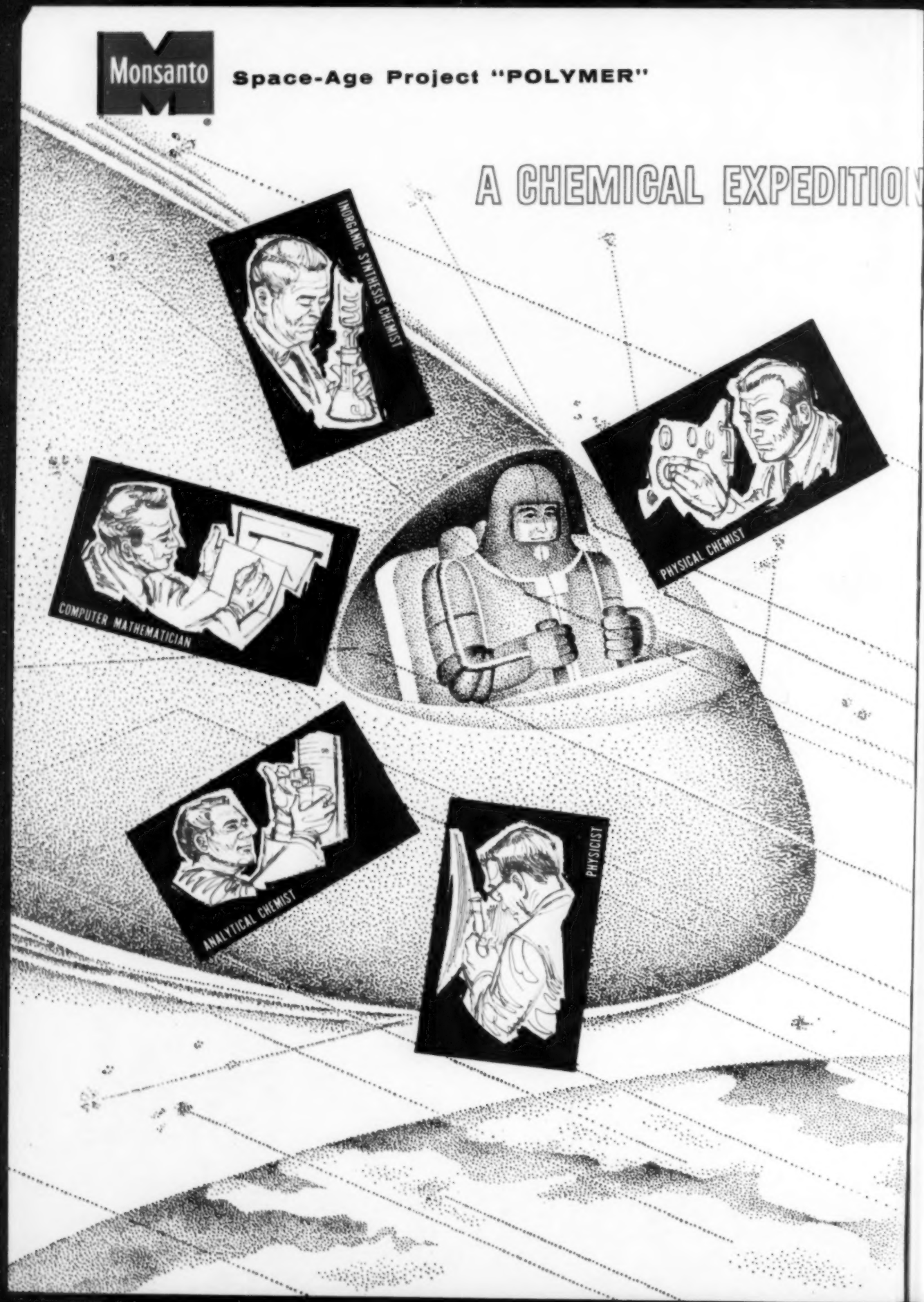
Monsanto
Space-Age Project "POLYMER"
A CHEMICAL EXPEDITION
INORGANIC SYNTHESIS CHEMIST
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PHYSICIST

deep in research on inorganic polymer structure... discovers promising clues to heat-resistant "plastics"

Recent Monsanto research work has uncovered new clues to a theory for predicting inorganic polymer bonds that have high resistance to rupture. Through use of inorganic chemical bonds with indicated polymer-structure capabilities, a number of make-and-see "pilot" polymers have been synthesized and have substantiated the theory. Conventional organic polymers have undergone tremendous commercial development. However, exploration into the new geometry of inorganic molecular structures has put Monsanto on the track of totally new and promising compositions of matter.

Is it possible to develop a "plastic" with rubber-like elasticity that will retain flexibility and a reasonable amount of strength without flowing at the temperature where ordinary glass melts —where iron glows red? What are the odds for discovery of a long-lived coating that would make clear plastic windows "scratchproof" . . . or a protective "heat-shield" wire coating that would permit electric motors to run efficiently up to 400°C.? These products and many more may well be found in inorganic polymers of carefully planned molecules.

Now, Monsanto chemists are exploring ways to catalog basic parameters that predict inorganic molecular structure. From application of this basic knowledge, inorganic chain structures may be tailored specifically to zero-in on promising inherent properties such as rigidity, elasticity, strength, stability and high resistance to heat. In general, organic polymers are limited to around 250°C., but more heat-stable inorganics might extend the polymer endurance range to 500°C. or beyond!

A NEW WORLD OF POSSIBILITIES

Actually, hundreds of inorganic polymers are already known, but few have the properties needed for space-age engineering applications. On the other hand, via atomic architecture, literally thousands of inorganic polymers are possible. Only a relatively small proportion of these have as yet been synthesized and examined.

To help predict the properties of inorganic polymers, Monsanto chemists have devised some new methods and adapted many recently developed techniques for characterizing chain structures. Applying elution fractionation to crystalline and amorphous polymers, they developed a new reliable procedure to establish molecular-weight distribution. To uncover other clues to inorganic polymer structure they have employed selective hydrolysis, solution chromatography, differential thermal analysis, and such techniques as nuclear magnetic resonance. Out of all this work on the riddle of molecular configuration have come some leads that may point the way to the "500°C. plastic."

At first inspection, the multiple deficiencies of existing materials are discouraging. But major goals are abundantly clear: chemically, the ideal inorganic polymer must not react with its environment; it must not decompose under heat and mechanical stress; it must resist molecular reorganization. Apparently, from the relatively slow progress that has been made toward these goals, something radically new and different is needed—totally new mechanisms rather than research modeled after organic polymer mechanisms.

IMAGINATION MAPS A RESEARCH ROUTE

A key to Monsanto's research approach is in *controlling* the structural reorganization of inorganic molecules. This chemical phenomenon has been well known in special cases, but its general importance to inorganic chemistry has only been recognized in recent Monsanto studies. Control of molecular reorganization may be the answer to designing useful, heat-stable inorganic polymers.

In order to create an inorganic material with elasticity, it is necessary to have straight-chain, only-occasionally-branched molecules able to assume various configurations . . . so the energy of deformation can be stored by reducing the configurational freedom. The elastic stretch comes from straightening molecules throughout the body of material. If molecular chains undergo simultaneous making and breaking with interchange of parts, there is no permanent elasticity, but rather, the properties of a viscous fluid.

In recent exploratory studies, molecules tailored for the purpose of controlling molecular reorganization have given clues both to patterns of stereospecific regulation and to "building blocks" that show promise. For example: "pilot" compounds of high molecular weight have been prepared based on phosphorus. The physical properties have been controlled to the point of turning out compositions in the form of elastomers or as rigid solids!

(Please turn page)

The rigidity is derived either by built-in cross-linking or by "sprinkling" ionic charges along the polymer chain.

Although the pilot compounds in themselves are not satisfactory, these polymers (and others) have revealed sufficient clues to prompt Monsanto research into a frontal attack on the problem of finding high-heat-resistant inorganic polymers in the jungle of chemical compounds that contain no carbon-to-carbon linkage.

INORGANIC CHEMICALS FOR CREATIVE SYNTHESES

Several novel combinations of selected elements offer promise of high stability—and Monsanto research has started examining the more promising ones. The search is two-fold: first, synthesis of the predicted polymer and study of its properties; next, "creation of clean reactions" to make it.

A variety of structures is under study, among them . . . compounds having phosphorus-to-phosphorus and phosphorus-to-carbon bonds . . . cyanofluorocarbons, isocyanate and ketene analogs with bonds between boron, carbon, sulfur and nitrogen . . . conjugated fluorocarbons . . . polymers containing the –C=N–C=N– skeleton . . . polymers from metal-phosphorus linkages, and others.

HIGH-TEMPERATURE POLYMER RESEARCH . . . a chemical capability of Monsanto

Over a dozen Monsanto research projects are aimed at the development of heat-resistant materials for structural use, for imbedment of electronic parts, for coating purposes, and for high-temperature fluids. Hopefully, even high-temperature elastomers may be developed for such uses as O-rings, diaphragms and gaskets.

If you are working on a problem requiring a heat-stable compound for special service, you are invited to discuss your needs with Monsanto. Write or call: Monsanto Chemical Company, Department MR-6, C Building, St. Louis 66, Missouri.

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THE MISSILE / SPACE WEEKLY

missiles and rockets

Volume 8, Number 26 June 26, 1961

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THE COVER

Fairchild Stratos Corp.'s highly regarded SD-5 Army reconnaissance drone is company's biggest contract winner and major factor in plans for the future. See p. 30.

JUNE 26 HEADLINES

First Details of NASA's S-48 Ionosphere Sounder 12
AF Solid Booster Expected to Cost $2 Billion 14
NASA Hustles to Fill 6000 New Job Vacancies 15
Pentagon Plans Drastic New Contract Approach 16
DOD Lists Top 100 Prime Contractors for 1960 36

ADVANCED MATERIALS†

Curtiss-Wright Pushes Motor-Case State of Art 24

SPACE SYSTEMS

OAO No. 3 Astronomical Satellite Described 26

EQUIPMENT SALVAGE

Navy Cleaning Process Cuts Fire, Flood Damage 28

MANAGEMENT

Fairchild's Uhl Sees Future in Big R&D Contracts 30

MACHINING

'Autopromt' Speeds Numerical Control Programing 32

INTERNATIONAL

Seaslug Test Success Leads to Okay for Mark 2 34

SPECIAL SECTION

Index of M/R Editorial Coverage for First Half of 1961—New, Easy-to-Use Alphabetical Listing 44

DEPARTMENTS

Letters 6
The Countdown 9
The Missile/Space Week† 10
Technical Countdown 23
Contracts 51
Names in the News 54
When and Where 55
Editorial 56

† U.S. Reg. Pdg.

35,630 copies this issue

letters

Space Drive Rebuttal

To the Editor:

An article in M/R, June 12 (p. 24) is entitled "Consultant's Report Overrides Dean Space Drive," and refers to an Air Force contractor's report.

The Drive is neither overridden nor buried. We have been concentrating here and in other countries on the strictly commercial and immediately realizable applications of the Drive. Space is not our business, but to make our position clear, please be informed that realizable projections of the Drive would take one man, or one hundred men, to the moon and bring them back as readily as the Queen Mary crosses the Atlantic. The only question is—what country does it first.

Analysis of the Air Force Rabinow adverse report shows that every reported test, except the first general set-up, was made under relationships or operating circumstances that are guaranteed to produce no positive result, and which are so stated in information that I gave to both the Air Force and its contractor, and which they had in their possession.

Questions of why these selected relationships were reported to and accepted by the Air Force as being an analysis of my loaned equipment should be directed to the Air Force. If the Air Force wishes to know of other ways in which this equipment will not produce positive results, I will supply them without the expense of a contractor. I believe, however, that the Air Force should be more interested in how unidirectional thrust is created than in how it is not. The Rabinow report appears to be dedicated to the latter proposition.

A detailed analysis of the fundamental errors in the report is in preparation. A copy will be sent to you.

Let me be clear. We are not engaged in a contest. There is no contest. We are going to have to live with the Drive whether we want to or not, for its success no longer depends upon any one person, group, agency or country. What we can do here is to demonstrate the responsibility required, I believe, by all of us. . . .

Norman L. Dean
Washington, D.C.

The balance of Mr. Dean's letter concerned the background of his work on the Drive and how he supplied information and test equipment to the Air Force.—Ed.

To the Editor:

I was rather shocked with the space that M/R gave the Dean gravity Whirligig (M/R, May 1, p. 24). It was gratifying, therefore, to see the contraption unhinged by Rabinow in the June 12 issue.

I would, however, like to put a final nail in its coffin.

In the May 1 article mention was made of the non-simultaneity of action and reaction. It is true of course that nothing occurs at infinite speed. The gravitic action of object "A" upon object "B" must incorporate a transport function. Similarly, the gravitic action of object "B" upon object "A" (and this is non-identical with the previous action) must also include a transport function. As a result gravitic actions and neither really mutual nor simultaneous.

Newton's laws are therefore exactly applicable only under special, tranquil conditions.

Fortunately, when we apply these considerations to a machine of the dimensions of the Dean machine, we find that any effects are completely swamped by such things as ordinary thermal agitation. As a result, if the machine were warm enough to run its gravitic effects could never be measured.

I was particularly interested in the Dean-Rabinow results since I built a machine along the same principles when I was an 8-year-old schoolboy. It worked real good as I remember and was powered by a Lionel train transformer. The only trouble was I could never get the thing to rise off the table.

Robert E. Span
Registered Engineer
Rector, Pa.

Tiros' Other Eye

To the Editor:

I note in M/R, May 29, p. 18 a paragraph concerning *Tiros II* having been in orbit for six months and still transmitting. I would like to call your attention to the fact that both television cameras are still operating. . . . A high percentage of pictures from both cameras are being used for meteorological purposes.

M. G. Staton, Manager
Market Development
Astro-Electronics Div.
Defense Electronics Products
Radio Corp. of America
Princeton, N.J.

M/R reported that Tiros II's narrow-angle camera was operating perfectly, failed to mention the wide-angle camera —Ed.

Yes, Anti-ASW

To the Editor:

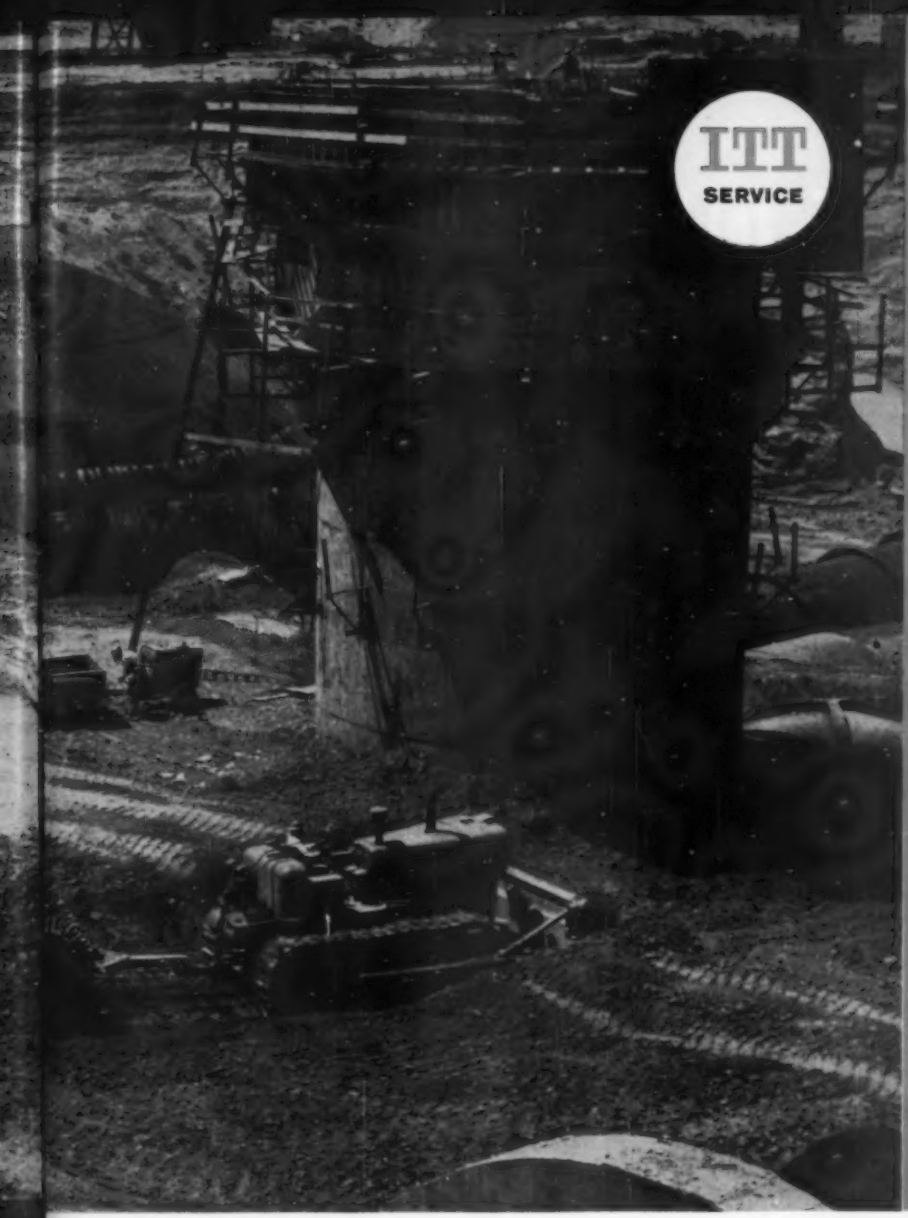
In reference to your COUNTDOWN feature in M/R, June 12, p. 9 (reporting that "the FY '62 budget contains $8.3 million for anti-ASW R&D work in the field of ship noise reduction"), I would like to remind you that ASW stands for anti-submarine warfare, and that, therefore, anti-ASW warfare would mean submarine warfare.

In our book, ship noise reduction would be classified as anti-submarine warfare.

N. A. Denman
General Manager
Basic & Experimental Physics
Falmouth, Mass.

As a matter of fact, the ships involved in the program in question are submarines. Hence, the work is properly categorized as anti-ASW (or, if you prefer, submarine warfare) R&D.—Ed.

■ Federal Electric Corporation President, J. W. Guilfoyle (on left), inspects typical underground passageway during initial phase of the complex's activation by FEC.



reporting from TITAN base T-4

...to military system managers

. . . operational readiness of the TITAN system has been assured by Martin Company's comprehensive planning for electronic technical support.

. . . the hard base TITAN complex at Larson AFB, Moses Lake, Washington, is now being activated by Federal Electric Corporation, Service Associate of International Telephone and Telegraph Corporation.

. . . TITAN prime contractor, the Martin Company, is calling on FEC for:

- Installation and test of Martin furnished TITAN ICBM's and ground equipment
- Interim operation
- Support services for other contractors on the site
- Assistance to Martin in turning the complex over to the Air Force

. . . this company was chosen to activate TITAN Base T-4 because:

ITT Service demonstrated to Martin system managers that its management, operation, maintenance and support would be effective, economical, and instantly responsive to program needs.

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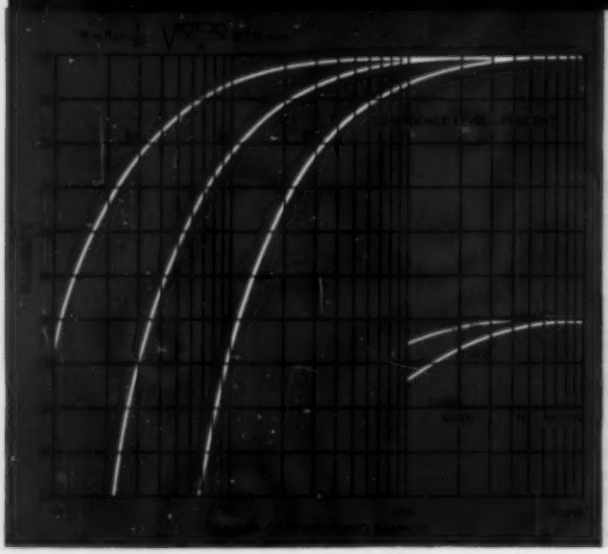

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The Countdown

WASHINGTON

Blue Water for Sergeant?

COUNTDOWN hears the U.S. Army top command is studying a field command recommendation to buy the English Electric *Blue Water*, instead of stocking Sperry's *Sergeant*. Argument from the men who have to shoot 'em: *Blue Water* will have a shorter countdown, less GSE and fewer "black boxes" to contend with. There is also the feeling that *Blue Water* (due to become operational in 1963) is more mobile and is generally a more advanced weapon—because of its eight-year development cycle—than the *Sergeant*, which is already operational in limited numbers.

How McNamara 'Leans'

Defense Secretary McNamara is sticking to his decision not to go beyond a 29-boat *Polaris* program; neither is he giving any indication of buying more than 600 *Minutemen* for the present. In newly released testimony before the Mahon Committee earlier this month, McNamara says it costs about $1 billion to: 1) buy 40 B-58's and operate them with tankers for five years; or 2) buy 45 B-52's with tankers and operate them for five years; or 3) buy 150 *Minutemen* in silos and maintain them for five years; or 4) buy 6 *Polaris* subs and operate them for five years. Ruling out B-58's because of their short range, McNamara says that if he did ask for another billion, "I would lean today toward either *Polaris* or *Minuteman*."

New Minuteman Sites Picked

Bases for 150 *Minutemen* each will be located at Whitman, Mo., and Minot, N.D. The sites for the six (50-missile) squadrons will round out the currently-planned force of 600 *Minutemen*. There are 150 going in at Malmstrom AFB, Mont., and another 150 at Ellsworth, S.D.

More AF Range Ships

Air Force is in the process of angling for three more mothballed Navy vessels which it intends to convert to range ships. Cost per conversion: $20 million.

Blimps' Demise

Unless Congress reverses the Administration, the Navy's dwindling ASW blimp force will die altogether as of June 30. Cut from 22 in FY '57 to a current total of 8, the blimp force will fade from existence for want of an appropriation amounting to only $5 million.

Marines Evaluating Entac

Already on order by the Army, Nord Aviation *Entacs* are being evaluated by the Marines. Some U.S. military men are now contending that *Entac* is the simplest antitank missile yet to appear on the market.

Ranger Launch Slipping?

There's word from Canaveral that the first launch of a *Ranger* lunar vehicle scheduled late next month may be delayed, although Lockheed is presently completing compatibility tests of the first proof-test model of the spacecraft with an *Agena B*. First and second shots of the *Ranger Agena (RA-1, RA-2)* will be to run engineering checks and to "road test" cislunar space. Not until *RA-3* will a lunar hard-landing be attempted.

INDUSTRY

Bambi—No Future?

While development is continuing as part of the *Defender* program, DOD R&E Chief John Rubel concedes that the *Bambi* satellite approach to knocking down ICBM's in the boost phase doesn't look very promising. Rubel says 25% of the *Defender* effort is now going into development of high-powered radar and other sensing devices.

R&D Intelligence

First flight rating tests of the Rocketdyne F-1 engine are now targeted for March, 1963. . . . Reynolds Metals estimates 35 million lbs. of fine aluminum powder will be burned annually by 1965 in solid-rocket firings. . . . A solid-fueled rocket fired last week by United Technology Corp., says the company, racked up highest overall performance ever recorded. Contributing factors: a lightweight glass casing, extremely thin insulation, uprated propellant and advanced nozzle design. . . . Air Force on June 21 fired the last shot in the *Mace B* development program. Launch crews from 4504th Tactical Missile Wing will begin training with the bird this summer.

Uneasy Bedmates

No arrangements have been made yet to coordinate Air Force and NASA solid rocket development (see p. 14). NASA is hoping it will have some say in how the Air Force spends the money—some $2 billion over the next three years. But it may get none at all. Question revolves around whether NASA will get responsibility for stage construction and integration—or whether the Air Force will take over the whole job, including motor development.

INTERNATIONAL

ONERA Builds Wind Tunnels

Two hypersonic wind tunnels—one Mach 7 and the other Mach 20—are now in operation by ONERA, the French counterpart to NASA. The tunnels are being used for re-entry vehicle design.

Overseas Pipeline

The British War Department's Proof and Experimental Establishment at Pendine, Wales, is now studying re-entry problems on a rocket-propelled sled. . . . More high-altitude tests with *Véronique* rockets are underway over Colomb-Béchar in North Africa. . . . Russia's Yuri Gagarin now says in a book he has written that during re-entry from his globe-girdling flight, his *Vostok* was enveloped in flame. "Its outer skin became hot rapidly," he says, "and through the blinds covering the portholes I saw the ominous purple reflections of the flame racing around the ship."

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Elgeet

EL-63

The Missile/Space Week

Typhon R&D Award to Bendix

Bendix Corp. has been chosen as R&D contractor for the Navy's solid-propelled *Typhon* missile system.

The system, which will have both antiaircraft and antimissile capability, will include shipboard control units, radar, launching systems and missiles.

General Dynamics/Pomona, subcontractor to Bendix, will develop parts of the guidance system. Johns Hopkins Applied Physics Laboratory conducted preliminary design work and will have technical direction over the R&D program.

Shot of the Week

A 150-ft. dipole antenna—the largest ever put in space—has been successfully tested at altitude. Fired up to 560 miles with a four-stage *Javelin* rocket, the two 75-ft. arms of the antenna were extended to length by radio command from NASA's Wallops Island launch facility.

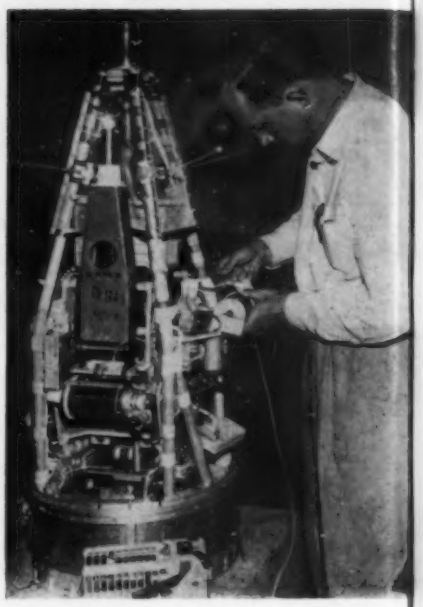
The antenna is so fragile and light —each arm weighs only seven pounds —that the extension procedure had to be tested outside the gravitational effects of the earth.

Although the experiment was reportedly less than 100% successful, project scientists were satisfied that the antenna had proved feasible.

The unique antenna is to be used in Canada's *S-27 Topside Sounder* satellite scheduled for launch early next year. The joint U.S.-Canadian experiment will probe the ionosphere from above, using a swept-frequency technique to explore propagation characteristics. (See related story, p. 12.) After the *S-27* satellite goes into orbit, it will be known as the *Alouette*.

The new technique used to store the antennas during boost and extend them in space was developed jointly by de Havilland Aircraft of Canada and the Canadian Defense Research Telecommunications Establishment.

Before extension, the antennas are stored as a thin (0.004-in.) steel strip rolled on a drum, similar to a coiled steel-tape rule. On command, a small electric motor unrolls the strip through a fiberglass guide sleeve which forms the strip into a tubular shape.



JAVELIN payload with record antenna.

Before extension, the payload carrying the antennas was programed to be spun up to 650 rpm. After extension, the spin rate was to be decreased to 135 rpm. This procedure was used to test the antenna's ability to withstand the spin forces it will meet in the operational spin-stabilized satellite.

The 62-lb. *Javelin* payload reached a velocity of 9200 mph on its 18½-min. flight. It landed in the Atlantic some 750 miles down-range from the Wallops launch site. Recovery was not planned or attempted.

Discoverer Netted

Discoverer XXV, launched June 16 from Vandenberg AFB, Calif., became fifth in the series to be recovered after orbit in space.

The 300-lb. capsule carried specimens of rare metals, radiation and micrometeorite counters.

Skindivers recovered the payload from the Pacific north of the recovery "ballpark" where Air Force C-119 planes were waiting to snag the capsule as it fell. The capsule ejected on command on its 33rd pass, after spending 50 hours in space, but fell slightly afield of the designated area.

The *Thor* booster stage of the vehicle was guided by radio command instead of the autopilot used by previ-

ous *Discoverers*. Satellite stage was the *Agena B*.

Air Force scientists are studying metals carried in the probe, which included gold, bismuth, iron, cadmium, magnesium, nickel and yttrium.

The Air Force had hoped to leave the satellite in orbit four days but terminated the mission because of predicted bad weather conditions in the recovery zone and technical condition of the satellite.

Advice on Advisers

The streamlining of scientific and technical committees now advising the President is urged in a Congressional staff study just released.

The study declares that an Office of Science and Technology should be set up within the Executive Office of the President. It would have two jobs: Make recommendations to the President for meeting long-term national needs in science, and help the President coordinate and evaluate agency programs by serving as technical counselors to him and to the Bureau of the Budget.

Head of the new Office would be the Special Assistant to the President (now Dr. Jerome K. Weisner).

It would also include the Federal Council for Science and Technology, the President's Science Advisory Committee, and an expanded special staff.

The study criticized the present setup, saying that the President's science advisers "had not yet done enough in helping the President and the Bureau of the Budget coordinate and monitor major government technical programs."

New Nuclear Manager

NASA has established a nuclear vehicle projects office at Marshall Space Flight Center to oversee development of nuclear rocket stages for *Saturn* and follow-on space systems. Chief of the new office is Col. Scott Fellows, USAF, under assignment to NASA. Deputy is William A. Brooksbank, Jr.

First project for the new office is to manage development of the *RIFT* vehicle, slated for *Saturn C-3* second-stage tests in 1966-7. *RIFT* will use the NERVA engine, now under development by Aerojet General and Westinghouse.

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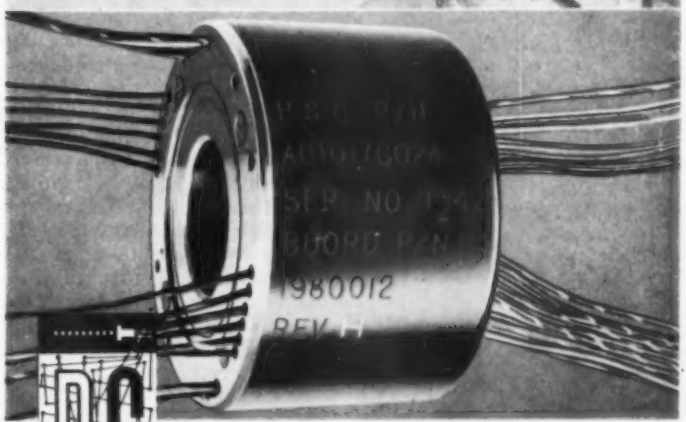

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Probing past F2 . . .

S-48 to Sound High Ionosphere

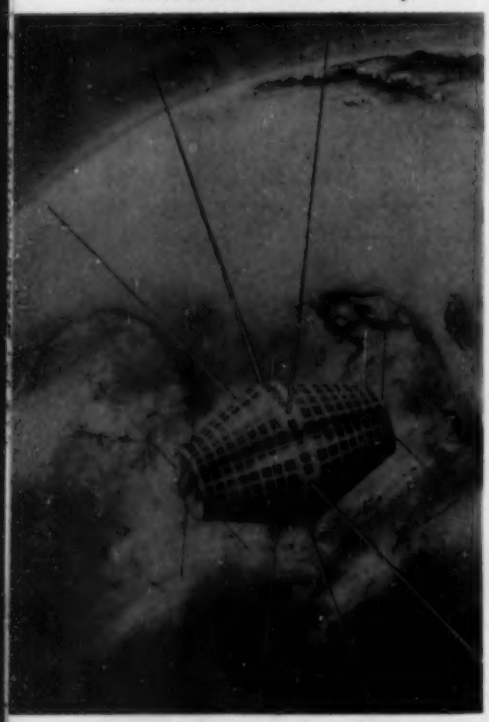
Fixed-frequency satellite will measure density of electrons; Canada's S-27 to use swept frequency

A MAJOR ASSAULT on the upper ionosphere will begin next year with the launching of America's *S-48* satellite—one-half of an international project to measure electron density above the F2 layer.

The project is aimed at collecting data important to high frequency communications and manned spaceflight.

The fixed-frequency *Topside Sounder* is being developed for the National Aeronautics and Space Administration by the Central Radio Propagation Laboratory of the National Bureau of Standards (NBS-DRPL) and by Airborne Instruments Laboratory, a division of Cutler-Hammer, Inc.

In a complementary project, Canada is developing a somewhat different ionosounder satellite which will be placed in orbit in early 1962, shortly before *S-48* is launched. Known as *S-27*, swept-frequency *Topside Sounder*, the satellite will round out the total *Topside Sounder* program.



LATEST NASA artist's conception of S-48, America's fixed-frequency Topside Sounder satellite, to be launched in '62.

NASA was to launch an *Argo D-4* rocket probe from Wallops Island, Va., last week in the first flight test of equipment being developed for eventual use in *S-48*.

The U. S., Canada and the United Kingdom will collect data independently from both *S-27* and *S-48* at ground stations around the world. Recorded data will be exchanged.

• **Nature's radio mirror**—The reflective and refractive characteristics of the ionosphere have been used for many years to increase radio transmission range. In recent years, by employing the scattering effect of the ionosphere, VHF point-to-point telecommunications have been used extensively by the military services. Ionospheric-scatter communications offer unusually high reliability and secure circuits, not intolerably degraded by sun-spot activities.

Yet little is known about this region. Through the study of effect, rather than cause, it is known that electron density in the upper atmosphere varies with altitude, time of day, season, latitude, and solar activity.

A more complete understanding of electron density in the upper regions will be determined through the *Topside Sounder* program by sending radio waves into the ionosphere from above and then by determining electron density as a function of altitude.

Such density maps already have been produced over the past 35 years by transmitting pulses from the earth with known but varying frequencies and by measuring the delay in return. However, these ground-based radio probes were able to reach only the maximum-density layer—about 200 miles altitude.

Recent sounding-rocket probes have indicated existence of ionized particles well above the F2 layer. These were all vertical-incidence type rockets launched before and during the IGY (International Geophysical Year); their results were extremely limited.

There are two dominant reasons for acquiring details of the topside electron density at all levels, said an AIL scientist:

1. The data are needed to improve prediction of the quality of high-frequency communication circuits, through better understanding of the ionosphere.

2. The topside of the ionosphere—a basic part of our near-space environment—must be better known before manned vehicles can be expected to operate with any degree of equipment reliability.

• **Conceived in 1958**—The present program was first conceived in late 1958 by a special subcommittee of the Space Sciences Board, directed by Dr. H. Booker of Cornell University. The board considered the feasibility of orbiting an ionospheric sounder, and concluded that it was encouraging.

Studies were continued through 1959 by NASA's Goddard Space Flight Center, NBS-CRPL, AIL, and others. Near the end of 1959, AIL and CPRL joined forces under NASA sponsorship to design and develop the *S-48* satellite and conduct the required experiments.

• **Four main objectives**—Orbiting a topside sounder should provide data in four areas:

—Electron density in the upper atmosphere at altitudes from 200 to 700 miles.

—Variations of these ionized-particle densities diurnally, seasonally, and with changes in latitude and geomagnetic disturbance.

—Plasma resonance frequency near the sounder.

—Cosmic noise intensity in the 3-15 mc frequency range.

• **Rocket payload**—Main purpose of the *Argo D-4* was to test the sounder equipment. The 48-lb. system included a storage battery (28-v, nickel-cadmium) power supply, single 2-frequency transmitter-receiver, a 2-channel FM/FM telemetering subsystem, programming, and control equipment.

After attaining altitude, the nose cone housing the sounder equipment was to be spring-jettisoned to bring two telescoped antennas into operating position at right angles to the longitudinal axis of the payload. Unfurled, the antennas each extend 16 feet outward.

The payload was destined for an altitude of about 700 miles. Alternate pulsed transmissions at fixed frequencies of 4.07 and 5.97 mc were to be made repeatedly. Transmitter r-f output power was to be about 35 watts.

Data received in the payload were to be transmitted over the VHF telemetry link to ground. The sounder pro-

vided three outputs: received signal strength, cosmic noise intensity, and echo delay time. Secondary objective of the rocket probe is the determination of electron density from 200 to 700 miles altitude.

This first firing was to be in the evening at a time when the ionosphere was considered "quiet" to minimize plasma-detuning of the sounder. According to a NASA spokesman, launch was to be soon after the time that radio penetration frequency of the ionosphere F2 region reached 6.5 mc on its diurnal increase, as observed from Wallops Island.

Another, similar sounding rocket will be launched soon during disturbed ionospheric conditions. The two shots are expected to yield sufficient data to support the satellite flights next year.

• **S-48 instrumentation** — Payload for the *S-48* satellite now under development will be packaged in two truncated cones, joined at their bases by a 40-in.-diameter x 6-in.-wide cylindrical center section. Length of the satellite will be about 3 feet. Weight is expected to be under 85 lbs.

Six dipole antennas, each nearly 33 feet long, will be erected after final separation.

The central canister within the payload will carry stacked telemetry circuit boards, the command receiver and radio sounder.

Each end of the satellite will carry the command, tracking, and telemetering antennas. The outer shell of the payload will be spotted with about 4000 solar cells for recharging the storage battery power supply.

Three dual frequency transceivers carried in the sounder will be used to transmit pulses sequentially at six fixed frequencies. These will be spaced logarithmically over the range from 3 to 15 mc. The transistorized r-f power amplifiers will probably have outputs well over 100 watts.

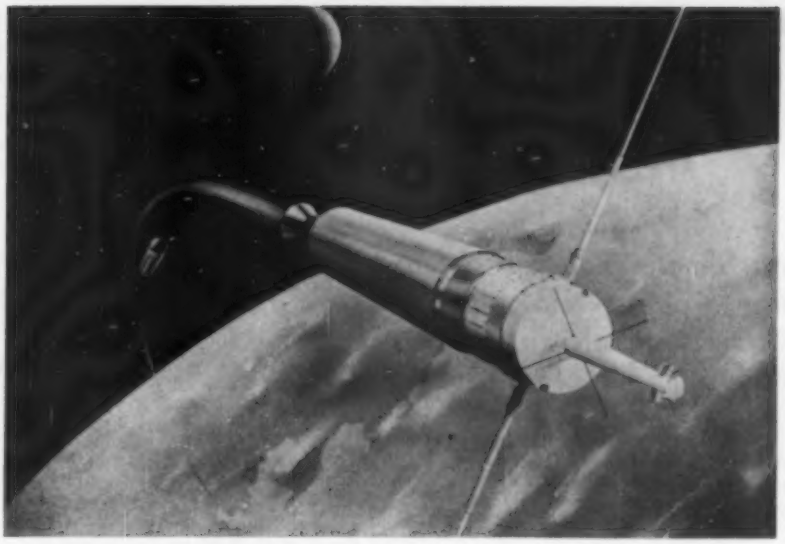
The satellite also will carry a tracking beacon and command receiver.

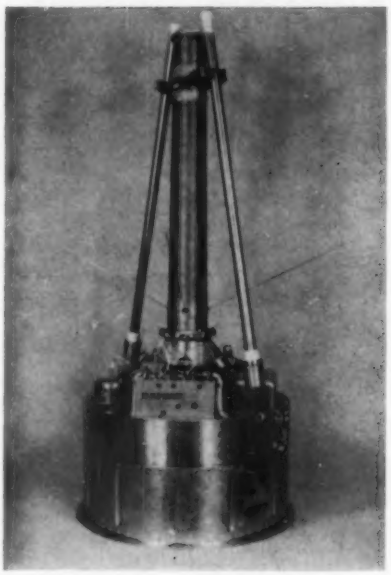
Design life of the *S-48* is from 6 months minimum to 1 year useful operation.

Launch will be by means of a NASA *Scout* booster from Pacific Missile Range into a circular orbit, at 80 degrees inclination, and at a proposed altitude of 700 miles.

• **Operation**—Each frequency will be transmitted from the dual-frequency transceivers for 100 microseconds. Then 15 milliseconds pause will be made for echo returns.

Each module in a transceiver will operate independently to enhance reliability. Frequencies selected will be such that none of the modules transmits adjacent frequencies in the 3-15 mc sequence. ⁂

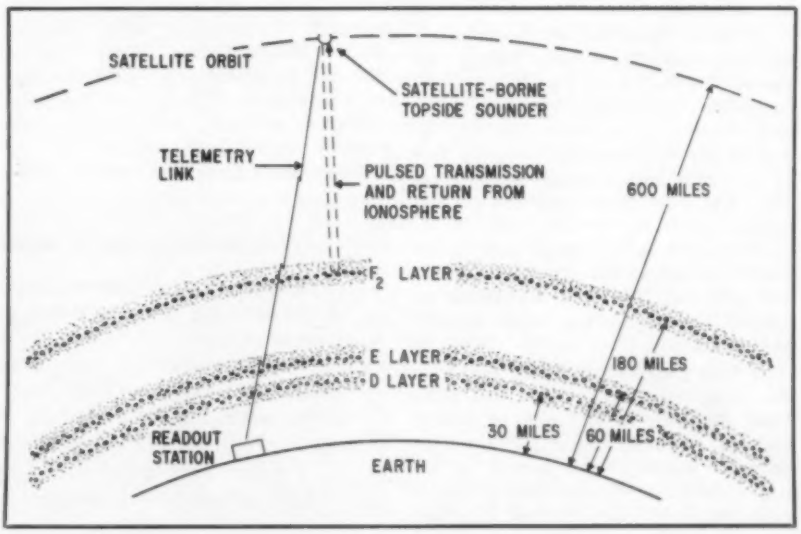




ABOVE: *Artist's rendering shows probe with antennas unfurled after jettisoning the nose cone at about 700 miles altitude.*

LEFT: *S-48 Topside Sounder development package built by Airborne Instruments Laboratory shown in unextended configuration. Central column supports spring to jettison nose cone. When clear, the telescoped antennas, clamped to center post, extend 16 ft.*

BELOW: *Diagram of principle of top-side ionospheric sounding. Following ground command, satellite sounder transmits radio pulses using six different frequencies.*



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Big AF Booster to Cost $2 Billion

McNamara indicates single firm will get final award; Grand Central strengthens hand with new facilities

CONTRACTING for the *Nova*-scale Air Force solid booster is now expected to reach $2 billion within the next three years.

The Defense Department is indicating, moreover, that development and fabrication of the huge booster—presently billed as strictly a "backup" to NASA's liquid *Nova*—will be undertaken by a single company.

Test and development phase of the solid booster alone is expected to cost $500 million. Special facilities, including launch operations and fabrication, are expected to run an additional $1.5 billion.

No firm plans have as yet materialized as to how the program will be managed. Aerospace Corp. is expected to initiate the early study phase. But the Air Force says it has not decided upon an agency to run the program—although it presumably will be one of the divisions of the Air Force Systems Command. Nor has the project been given a name.

Major contenders for the big contract are the Rocketdyne Division of North American Aviation, Grand Central Rocket, Aerojet-General, United Technology Corp., and possibly Hercules Powder.

Defense Secretary McNamara, in newly released testimony before the House Defense Appropriations Subcommittee, said proposals may be solicited from two or four contractors. Apparently two contractors would then be chosen to do preliminary work—with one eventually named to carry out the project.

Study phase of the project is expected to extend through the summer and early fall. The critical decision on naming a contractor may come as early as December.

• **New giant?**—Depending upon how the competition comes out, a new giant could be born in the solid-propellant industry, presently dominated by Aerojet and Thiokol. In awareness of the size of the stakes, Grand Central Rocket is preparing to take a $10-$15 million gamble to beef up its facilities.

The company announced last week it is "going full speed" on the construction of curing and mixing facilities and test stands on a 5000-acre site in the mountains near Protrero, Calif. The facilities are to be ready in November—when the company expects the Air Force to conduct a survey of contractors to determine who is best equipped and qualified to carry out the project.

Other companies recently have decided to undertake expansion moves or have completed them. Aerojet has put a new continuous-mix plant on stream; Rocketdyne has purchased several thousand acres near Reno, Nev., for an advanced solid propellant research facility; and UTC is completing construction of a multimillion-dollar solid plant near San Jose, Calif.

The Air Force has this break-down of the $62-million downpayment for the program requested in President Kennedy's last revision of the FY '62 budget (M/R, June 5, p. 12): $50 million for RDT&E on the booster; $2 million for planning a test facility; $10 million to design and start construction of the test facility.

• **Noise hazard**—There is a question as to where the test stands and launchers for the big booster may be located. The Air Force feels a booster developing 2-to-3-megapound thrust will require clearances from populated areas of from 25 to 30 miles because of the noise level.

Cape Canaveral may be ruled out—unless some offshore facility is developed. Vandenberg AFB and the Pacific Missile Range's Point Arguello also may be passed over—either because they lack space or because of the polar trajectory problem. If an entirely new base is established—perhaps on the equator—an almost completely new range with ground instrumentation would be needed.

The $1.5 billion estimated for facilities by McNamara could provide funds for an entirely new launch complex—and a fancy one at that.

McNamara was asked whether the military solid-booster program related to *Dyna-Soar*. The defense secretary replied by leaving the door wide open:

"Not specifically at this time. . . . It is conceivable that at some point in the future our military requirements would necessitate placing a man in space, but we do not see any need for that in the immediate future, and we are not requesting the large booster for that purpose, but rather for the purposes of putting equipment in space."

For the moment, the big solid booster is regarded as complementing NASA's liquid *Nova*—and at some point about three years from now a choice may be made between the two. On this question McNamara told the subcommittee:

"I do not anticipate this will be done without considerable agony and controversy."

However, he avoided mention of the point that three years may bring considerable changes—which conceivably could justify both a liquid and solid program.

At another congressional hearing last week, attention was focused on the problem of public acceptance of NASA's manned lunar expedition. Said Sen. Warren G. Magnuson (D-Wash.) to NASA officials:

"As it stands now, it appears to the people and to Congress . . . that we are just making a jump to the moon."

In view of the cost, he added, "I think NASA has got to do a lot of missionary work." #

NASA Schedules Apollo Industry Conference

NASA is holding an industry technical conference on the Apollo manned spacecraft in Washington July 18-20. The three-day session, classified confidential, will go into all phases of the system.

Presentations are to be made on the vehicle system, mission profiles, navigation, guidance and control, spacecraft propulsion, space environment, heating, onboard systems, landing systems, and crew participation. There also will be discussion of the design and operational aspects of Mercury as they pertain to Apollo.

A bidders' conference will be held about Aug. 1. A prime contract to design and build the Apollo spacecraft is expected to be awarded about next January.

60-man-year effort . . .

NASA Hunting for 6000 Recruits

Agency teams are missing no bets in 18-month drive to sign up scientists and technicians; salary gap is main problem

by Hal Gettings

NASA IS EMBARKING on a country-wide recruiting campaign of staggering proportions to fill an estimated 6000 positions during the next 18 months. Anticipating the large increases required by the accelerated space program proposed by President Kennedy, NASA Administrator James Webb says that the present effort must be increased by more than 50% in FY '62, and by almost 100% in FY '63.

Of the 6000 vacancies, some 2400 require engineers and scientists—a "hard" labor market at best. Technical people are needed in practically all 85 categories of "aerospace technology." Consequently, the current effort is a broad one and interviewers will talk to anyone whose qualifications fall anywhere in the area.

It is in the technical area that the recruitment program assumes its most impressive dimensions. On the basis of past results, recruiters will have to interview some 120,000 people to yield the desired 2400. Although NASA per-person recruiting costs are at the low end of the industry average—about $750 each—overall expenditure will total close to $2 million.

On the basis of one hour per interview, it will require some 60 man-years of effort to conduct the interviews. Since a recruiting team usually includes high-level scientific talent from the facility requiring personnel, the effort represents a considerable expenditure of valuable project time.

• **Salary gap**—Low salary scales are the toughest obstacle for NASA recruiters. A salary gap of up to $1000 exists between industry and civil service levels for BS degrees. This gap increases to above $3000 at the doctorate level. In some cases, PhDs can make twice as much in industry as in a comparable job with the space agency. As a result, NASA has found it impossible to hire PhDs fresh out of college. The majority of high-level scientific jobs at NASA go to scientists from other government agencies.

Some relief for this upper-level gap is in sight through legislation presently before Congress to increase the number of "excepted" positions. An amendment to H.R. 6874 would provide a total of 425 such positions, an increase of 135 over the present authorization of 290. This would allow annual salaries up to $21,000 for 30 positions and $19,000 for the remaining 395.

Webb, testifying last week before the House Subcommittee on Manpower Utilization, said the proposed increase "is essential to meet the critical staffing needs NASA must fill during the next 18 months." He pointed out that it is a matter "of considerable urgency" that NASA begin recruiting for these additional positions, "particularly in the projects affecting the manned lunar landing and nuclear rocket engine developments."

Congress will consider this request at the same time it considers the accelerated program of funding recommended by Kennedy.

No solution to the problem of recruiting lower-level technical people is near at hand, however. Although the salary gap is not so great for run-of-the-mill engineers, NASA still has a problem in competing with industry scales.

Even in areas of a "soft" labor market, recruiters have found rough going. In Cincinnati, for example—where General Electric has released hundreds of engineers and scientists due to cancellation of ANP contracts—interviewers had much less success than expected. They were able to attract competent individuals only "up to the point of salary offers."

• **Hole cards**—In spite of the problems, NASA is meeting with some success. One of its prime advantages is the challenge and interest inherent in space exploration. Robert Tiemann, chief of recruitment, says this is a big factor in attracting desirable personnel. In addition, he says, many persons have a commendable desire to serve their country. But he admits that such altruistic individuals are regrettably few.

NASA is not overlooking any possible personnel sources. The overall campaign is a multi-pronged effort that includes about every known recruiting gambit. In addition to conventional methods and areas of operation, NASA has several sources unavailable to industry.

One of the most fertile sources is the military. Through agreement with the services, NASA obtains a considerable number of highly trained officers on assignment. Such officers enjoy the relative freedom of civilian employment while retaining their military status and its inherent advantages. They wear mufti and are practically isolated from the military regimen. They are paid by their respective services, which are, in turn, reimbursed by NASA.

Foreign scientists are recruited through the Joint Operations Intelligence Agency of the Joint Chiefs of Staff. This provides a source of highly qualified PhDs unobtainable in this country due to the salary gap.

NASA also has a working agreement with the military for assignment of qualified ROTC officers for periods of 1½ to 3 years. The majority of these officers remain with NASA on completion of their active duty tours.

Professional conventions and meetings are worked hard by recruiting teams. These teams work both with the "career centers" set up at meetings and in independent recruiting operations.

Teams from the various NASA research centers and headquarters often coordinate their recruiting in intensive efforts aimed at particular population centers and areas where technical employment has been cut back. Cincinnati and the Dallas-Ft. Worth area have both been visited. San Francisco is next on the schedule, with other large cities to follow.

NASA also works with both U.S. and state employment services and does considerable college recruiting. A scheduled intensification of the college program is expected to yield 400-600 new graduates in the next year or so.

The personnel division has done much to streamline within the civil service recruiting procedure. They say that thanks to their coded job classifications and up-to-the-minute requirement lists very little time is required between interview and job offer. Normal time is two to four days, although this can often be shortened to one day. ⌗

NSIA meeting hears . . .

Pentagon Plans New Contract Approach

'Cost-plus-award-fee' expected to replace many 'cost-plus' R&D awards; more incentive-type contracts with bigger profit spread

by Hal Taylor

THE DEFENSE DEPARTMENT is planning to unveil a new "cost-plus-award-fee" contract within the next year.

Department officials said that the new contract—still in the idea-concept stage—will probably replace a large number of "cost-plus" contracts in the research and development field.

The outstanding feature of the contract, as revealed by Assistant Secretary of Defense Thomas D. Morris at a symposium of the National Security Industrial Association (NSIA), is the payment of an award fee ranging from −5% to 15% of the contractor's costs as estimated when the contract is drawn —after the contract is completed.

In other highlights of his address, which seemed to portend a minor revolution for DOD contracting, Morris said:

—The department intends to increase the use of "incentive-type" contracts in its programs.

—The spread of profits in incentive-type contracts should be increased from the present range of 4½% to 9% to, say, 0% to 15%.

Morris said that the ultimate award under the new contract "might be determined by a board of qualified judges made up of carefully selected professional people."

Their determination, he said, would be made after completion of the contract and would be based on total, overall performance, quality and reliability of the product, compared with original military requirements.

Morris noted that the board of judges would have to be impartial, professionally qualified people who would be appointed by the Secretary of the armed service awarding the contract. Decisions would be on the basis of demonstrated results.

• **The trouble area**—In calling for increased use of incentive-type contracts, Morris pointed out that while there has been a steady decline in fixed price contracts, the percent of dollars awarded under cost reimbursement (principally cost-plus-fixed-fee) contracting has risen from 13% of total procurement in Fiscal Year 1951 to more than 42% in Fiscal Year 1960.

Of that $9 billion, he continued, "only $672 million was under incentive-type contracts." This area, Morris noted, represents one-third of total Defense Department procurement and "is the area where we must take steps to increase incentives."

Morris said that the present spreads in incentive-type contracts "do not give the contractor a big enough incentive to go all out to reduce costs." He added, however, that they also do not impose "sufficient penalties for poor performance."

Morris said that DOD has had some initial favorable reactions to the proposed "cost-plus-award fee" contract. "We feel," he continued, "that this would offer a challenge to industry leaders to demonstrate the abilities of their companies to do a quality job—and to demonstrate this ability in such a manner that a Board, not involved in the contract, is convinced that a quality job has been done."

• **Approval**—A spokesman for NSIA—whose membership included about 90% of DOD contractors—said that the initial reaction of industrial officials at the conference was favorable.

Industry feels that something must be done to reduce costs of Defense Department hardware and increase the profits of the defense industry, he declared.

"We feel that if you only apply the profit motive to contracts you will slice into the cost problem pretty fast."

He added that while there is some question as to whether the new contract is legal, he felt that the Defense Department would go to Congress to get statutes changed, if necessary.

He noted that the seriousness with which industry views the effort to reduce defense costs through the profit motive is sharply pointed up by the speed by which it has moved to study Defense Department recommendations. He said that NSIA's Program Advisory Planning Committee scheduled a meeting for last Friday to start a study leading to an industry position.

'We Will Not Tolerate . . . Inefficient Practices . . .'

SECRETARY OF DEFENSE Robert S. McNamara served notice last week that the department is serious in its efforts to reduce the costs of defense programs.

He told a symposium of the National Security Industrial Association (NSIA) that "we will not tolerate, we will not accept, we will not sponsor uneconomical and inefficient practices, whatever their source and whatever their intention."

Calling on industry to cooperate with the department in increasing the cost benefit ratio in defense contracting, Secretary McNamara suggested that industry and government must work to:

—Simplify specifications and rationalize tolerances in contracts.

—Reduce development time through real analysis, and sometimes by a drastic overhaul of decision-making processes.

—Obtain more reliable cost estimates.

—Control engineering changes after an item has gone into production. It is essential that the improvement arising from an engineering change be worth the cost.

—Simplify Defense Department procurement and the procurement procedures used down through all the tiers of the subcontracting structure.

—Streamline the reporting requirements imposed by the Defense Department. As an example, he said, in requesting maintenance information it is frequently unnecessary to provide exact dimensions or processing data on component parts.

—Eliminate uneconomic and inefficient conditions, whether imposed by management or labor.

"These seven problem areas are only examples of the many fields in which we can find opportunities for cost reduction. I am aware that some of our internal policies, procedures, and methods of operation make industry's job more difficult. Some of these can be modified, and efforts are under way to achieve these modifications," Secretary McNamara said.

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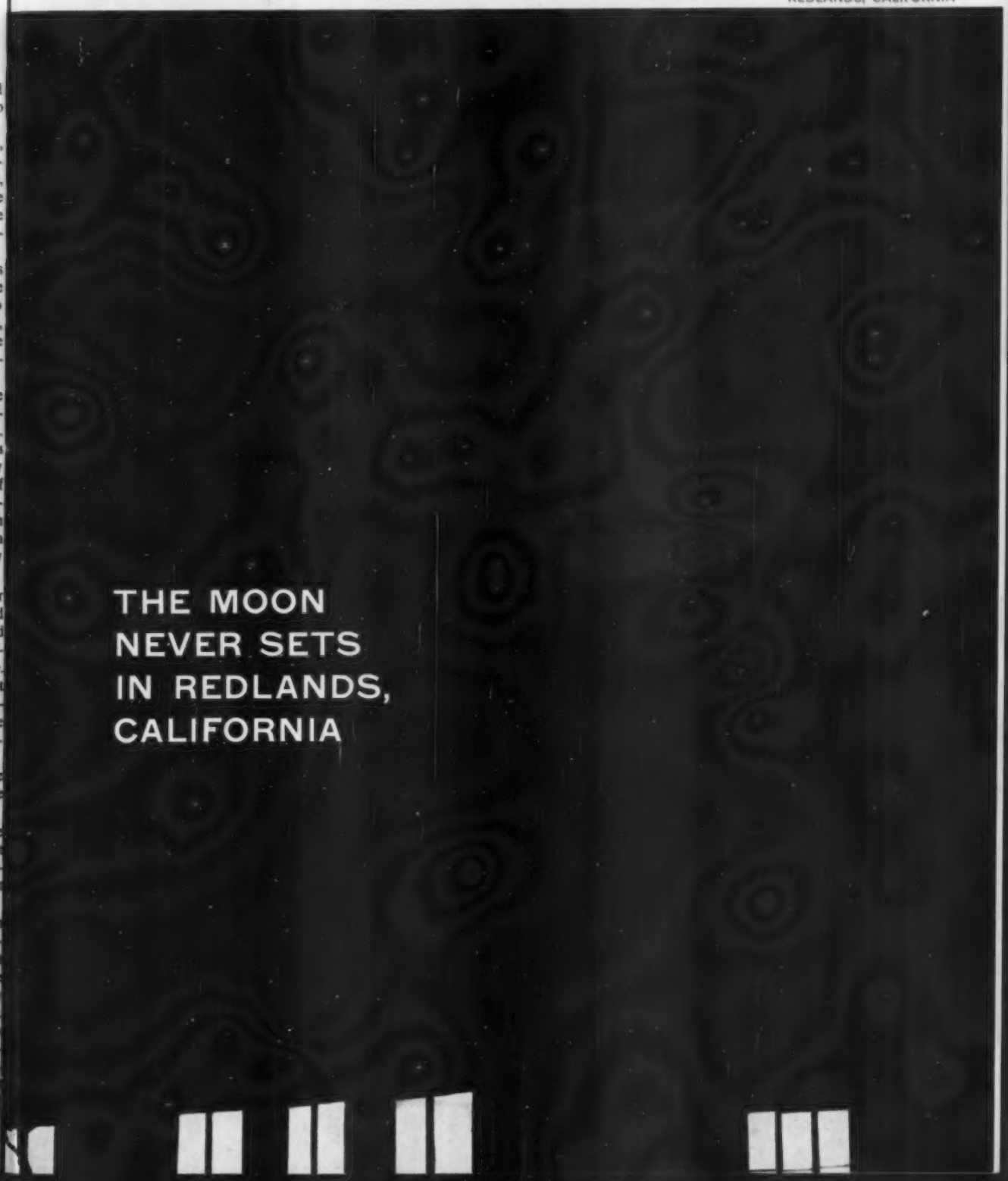

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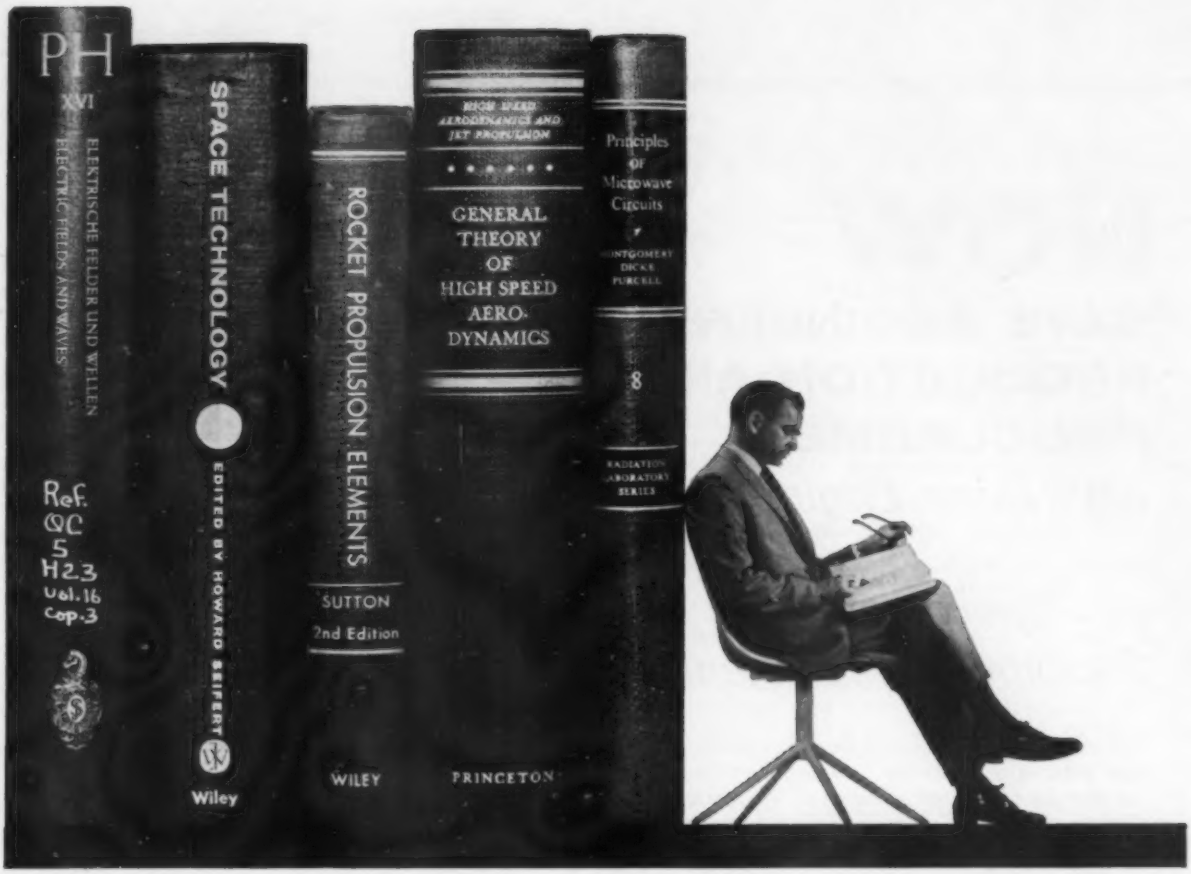

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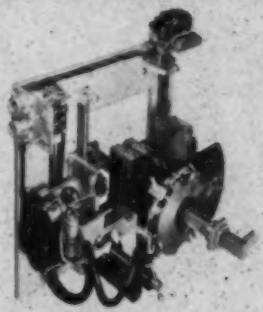

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SUPPORT EQUIPMENT

Wallops Tracking Net to be Updated

NASA will update its Wallops Island, Va., space-probe tracking facility with $300,000 worth of new equipment. Under a contract with Cubic Corp., three AGAVE acquisition aid and telemetry systems, a master control console, and a 150-ft. boresight tower for tracking system calibration will be added.

Air-Trailer to Ferry Space Vehicles

A unique "air-trailer" is being proposed as one possible solution to the problem of transporting large space vehicles. As conceived by Ling-Temco Electronics, such a craft would be a large glider attached to its tow plane by a semi-rigid tow bar. One model on the drawing board would be 160 ft. long and have a wingspan of 210 ft. It could carry loads 24 ft. in diameter, 90 ft. long, and weighing up to 50 tons.

New Data Transmitter Revealed

ACF Electronics will soon demonstrate its new communications system for handling the high-speed simultaneous transmission of digital data from multiple sources. The expandable modular system is adaptable to all types of existing teleprinters, facsimile machines, etc., for transmitting over a single standard telephone line at rates up to 4800 bits/second. As many as 16 different machine inputs can be handled at once, the division claims.

Big Wind at El Segundo

Douglas Aircraft's new hypersonic wind tunnel—capable of mach 10 velocities—became operational last week at the El Segundo Aerophysics Laboratory. The $2-million facility—the largest industry-owned tunnel in the U.S.—can test aircraft and missile models up to 36 in. long and 6 in. diameter. Tremendous high-pressure storage tanks give the tunnel test-run durations of up to four minutes.

Alaskan Air Defense Strengthened

Recent additions of electronics air defense coordination systems (ADCS) to the Alaskan Command are now fully operational. Each ADCS is composed of one Army air defense system, one AF interceptional control system, and a central tactical console. Target data from acquisition radars are funneled into the operations central for display, and to all battery units. The air defense commander can monitor the overall situation and assign targets for either missile or aircraft interception.

ADVANCED MATERIALS

Windows to Lighten Satelloons

The weight of balloon satellites can be reduced by about 30% by chemically milling a pattern of circular windows—or lightening holes—in the aluminum coating of the plastic spheres. The network of aluminum remaining will preserve the desired rigidity of the sphere in space, according to G. T. Schjeldahl Co., which is investigating the development for NASA.

New Plastic to Up Rocket Performance

Operation of rocket engines at temperatures up to 10,000°F may be possible with new plastic materials and self-cooling techniques. A new composite of ceramic, refractory, and plastic—being developed by Hughes Aircraft for the Air Force—is expected to resist even supersonic rocket exhaust velocities for several minutes and result in higher-performance aerospace propulsion systems.

PROPULSION

Conical Solid Out?

The originators and principal promoters of the conical solid-rocket concept, United Technology Corp., told a joint Army-Navy-AF meeting in Denver recently that if the government wanted to buy a large solid rocket from UTC, the final product would have a zero-degree taper. In other words, it would have to be cylindrical.

New Pluto Reactor Design Complete

Lawrence Radiation Laboratory has completed design of the *Tory IIC* reactor for Project *Pluto*, and is now fabricating components. Reactor for the nuclear ramjet is full-scale missile size, rather than a scaled-down model such as the small *Tory IIA* initially used. Tests of the *IIC* will involve about one million pounds of air, heated to 1060°F, and will dispense with water-cooling used in first runs. LRL says it expects additional problems to crop up during testing, but is encouraged by progress made with *IIA*.

ASTRONAUTICS

Glider Best for Re-entry?

Maneuverable space gliders offer advantages in flexibility, comfort, and safety that make them the best choice for re-entering the earth's atmosphere after deep-space missions. But two Boeing Co. engineers who advocate the glider say it might be too heavy for any rocket currently in use, and would have to await further booster development. Also, the greater heat generated by a glider vehicle on re-entry would require advanced concepts for heat protection.

Exploding Cannister to Carry Echo

Echo balloon satellites will be packed for their trip into space in magnesium containers designed to explode apart after ejection. Separation of the two halves of the container by a shaped charge will free the 500-lb., 135-ft. sphere to be inflated and orbit the earth as a communications reflector. Grumman Aircraft will build the containers for NASA.

Space Roles to Be Divided?

Some industry observers foresee eventual resolution of current Air Force-NASA battle over space missions through NASA returning to its pre-*Sputnik* role of research organization while Air Force—and possibly commercial firms—conduct hardware portions of space activities. Some research-minded factions in NASA are reported to welcome such a possibility as a step toward regaining the integrity established during years of detached "no-axe-to-grind" activity.

Centaur Schedule Affects Mariner

Changes in *Centaur* vehicle status are being evaluated by Jet Propulsion Laboratory as to the effect upon its planetary exploration program. Greatest effect is expected to be felt in *Mariner* shots at Venus. Other programs probably will stay on schedule.

Curtiss-Wright Deep in Motor Case Te

Experience in metallurgy spawns fresh approaches to problem of containment of energetic solid fuels

by John F. Judge

WOOD-RIDGE, N.J.—Lessons learned in more than 45 years of metallurgical experience are cutting the expense of fabricating *Minuteman* and *Pershing* motor cases at the Wright Aeronautical Division of Curtiss-Wright Corp.

One technique eliminated pre-heating in the critical weld areas of the *Minuteman* case. This simplified the process by removing the need for heated, expandable mandrels, and reduced tooling and equipment demands —all of which means increased production speed and lower unit costs.

The firm has never had a case rejected or returned by Thiokol Chemical Corp., prime contractor for the first-stage *Minuteman*. Several weeks ago, a case was pressure-tested to burst, and the failure agreed with prior theoretical considerations. The break occurred in the base metal area—15.5% above the uniaxial burst level indicated by the Von Mises theory.

Work now under way will lead to automation of blast tube welding on aft closures. This complex joining job is currently being done by hand. Reducing it to automated techniques will increase the reliability and efficiency of the welds.

There is full metallurgical coverage through every step of the complicated fabrication, even though some of the segments are entrusted to outside vendors.

High-performance cases have been almost entirely fabricated from machined forgings of D6 steel, but WAD is moving swifty into the roll-forming method. Roll-forming, or shear spinning, drops the number of discrete cylinder sections in each case from five to two; facilities available at Hufford Corp. may make one-piece *Minuteman* casings a reality.

Roll-forming reduces the expensive raw material requirement for a first-stage motor case by 75%. WAD is already incorporating roll-formed sections into production cases.

Shear spinning is not new to WAD engineers and metallurgists. The division had been developing spinning methods for the Air Force's Air Material Command two years prior to motor case applications.

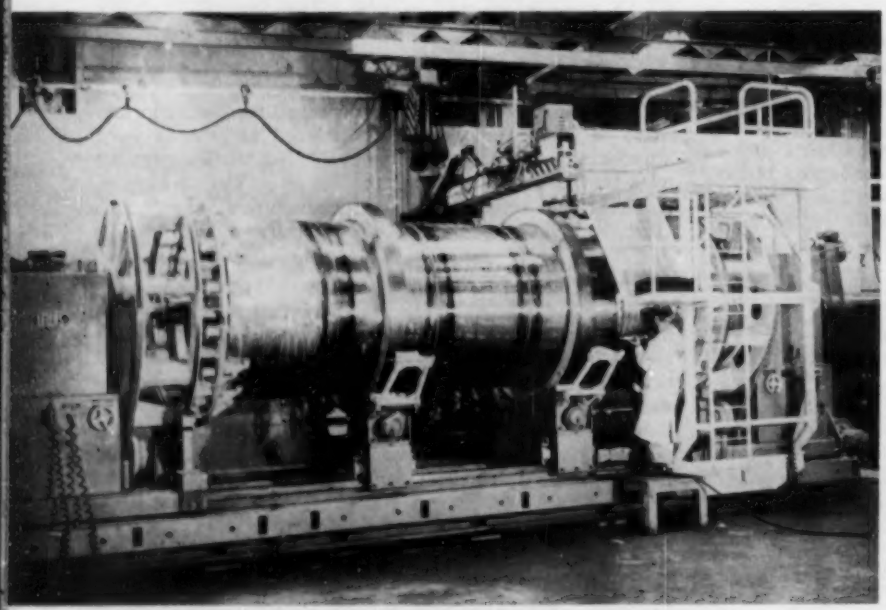
• **Functionally facilitized**—The *Minuteman* and *Pershing* production facilities are currently in a state of flux at WAD. New machinery is being installed and existing apparatus is being shifted. This improvement in production flow is being accomplished without interrupting the division's motor-case output.

The Navy's Program Evaluation and Review Technique (PERT) with an IBM program schedule has been adapted to the *Minuteman* project at WAD.

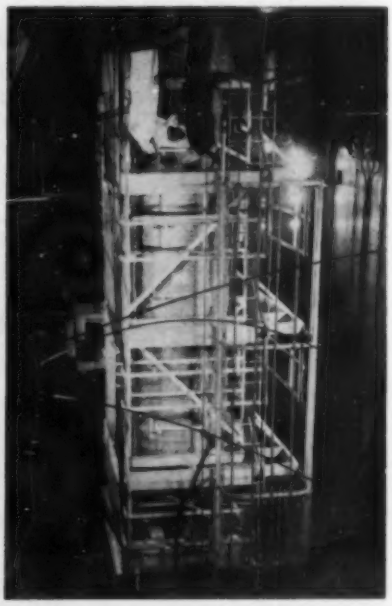
Early *Minuteman* work at WAD involved exploring a number of alloy compositions and fabrication techniques. Materials included were 4130, 6428 and Tricent steels. The firm supplied a flight-weight first-stage case using air-melted steel. The demand of reliability forced WAD into vacuum-melted steels.

Several ideas are being developed to cover other materials and fabrication methods for high-strength motor cases. Recent studies with 50 to 25% nickel-containing alloys from International Nickel Co. show promise—especially with regard to shear spinning.

One heat of the 25% alloy has been evaluated, and yield strengths of 250 to over 300,000 psi with good ductility and excellent notch toughness have been obtained. These steels utilize nickel to lower the transformation temperature.



AUTOMATIC WELDING the segments of the Minuteman first-stage motor case. Curtiss-Wright has developed a technique that eliminates the necessity for pre-heating.



BURST-TEST tower. Unique, conservative static test uses oil instead of water.

seTechnology

In addition, aluminum and titanium are added to allow further adjustments of transformation temperature, depending on whether these elements are dissolved in or precipitated from the iron-nickel solid solution.

• **Reaching for 300,000 psi**—Beside the high yield strengths of the 25% nickel steel, remarkable notch toughness has been observed. In one case, an experimental pressure vessel burst at 278,000 psi (based on S = PR/T). But a large forging lap which extended 0.052 in. through the 0.070-in. wall was discovered after ductile failure along the entire length of this vessel.

Shear spinning methods are particularly suited to the 25% steels. It has been found that large increases in tensile properties of conventional rocket-case steels can be achieved by interrupting the quench from the austenitizing temperature and deforming the steel while it is still in the austenitic condition. This means using the shear spinning process to warm-work the metal—at 800 to 1000°F.

With the 25% nickel steels, the deformation of the austinite prior to transformation can be done at room temperature.

In the conventional steel, girth welds would not attain the benefits of the warm-working because the welding is done after the working and the heat of welding would remove the warm-worked properties in the areas adjacent to the weld.

This pitfall can be avoided in 25% nickel steels, say WAD specialists, by locally cold-working the weld joint through shear spinning as the welding assembly of the case progresses.

WAD metallurgists caution that there are still problem areas in the nickel steels and that the development is still in the early stages.

Another wrinkle being pursued in the development labs at Curtiss-Wright is the potential of helically interlocked titanium tape-wrapped pressure vessels. The tapes have "I" beam and channel cross-sections and are wound on a removable mandrel so that they lock each turn with the preceding turn.

The interlocking tape concept avoids the welding problem inherent in B120VCA titanium alloy. In addition, cold-working the base weld wire material into the necessary cross-section brings the strength level of the metal up to 300,000 psi—which, if fully utilized in a motor case, would result in a strength-to-density ratio of about 1.7×10^6 in.

The final tensile strength of 250,000 to 300,000 psi is obtained by aging at 700-750° for 12 to 25 hours, depending on the extent of cold reduction.

Fore and aft sections are wound into the vessel by grinding similar interlocking features into the solid closure.

Like the nickel steels, the tape-winding method is still in development. Wright Aeronautical received support for the project from the Army's Ordnance Materials Research Office.

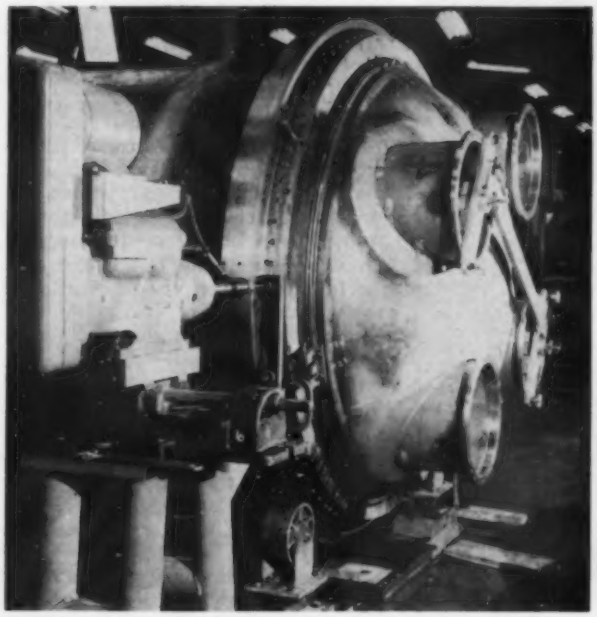
• **Vapor-deposited cases**—Even further back in the research stages is a series of studies on the application of thin-film technology in metals to motor cases—which could increase their strength by a factor of 10 over current materials.

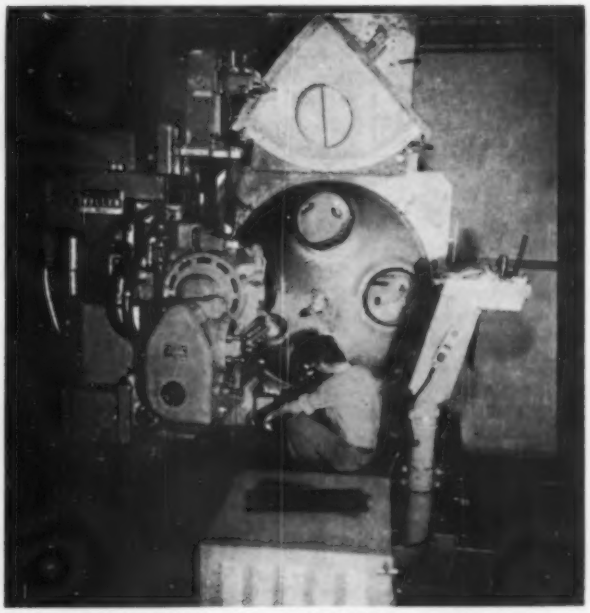
Work performed at the University of Virginia has shown that as film thickness goes down, a point is reached at which the strength increases abruptly. WAD is sponsoring research conducted in this area by the Brooklyn Polytechnical Institute, under direction of Professor Carmine D'Antonio.

The basic idea is to build up several thousand layers of thin-metal films, possibly deposited on the inside of the motor-case mold, to a total thickness of about 0.020 in. To retain the high strength, each layer must remain discrete from the next so some suitable coating material, such as an oxide, must be applied between each film segment.

Curtiss-Wright is not restricting its capability to motor cases—either in the current state-of-the-art or beyond. The Wright Division has over 1000 engineers and it is still hiring. Metallurgy alone accounts for over 112 engineers. Corporate energy is being expended in the field of nozzles for large solid rockets, and in other areas related to the missile/space field.

One current program at Fansteel Metallurgical Corp. involves the spinning of tungsten sheets into cones. Ultimately, complex nozzle shapes will be fabricated, reduced on a mandrel at 2000°F. Long-range plans include materials programs in reinforced plastics, steel, and graphite. ⌗





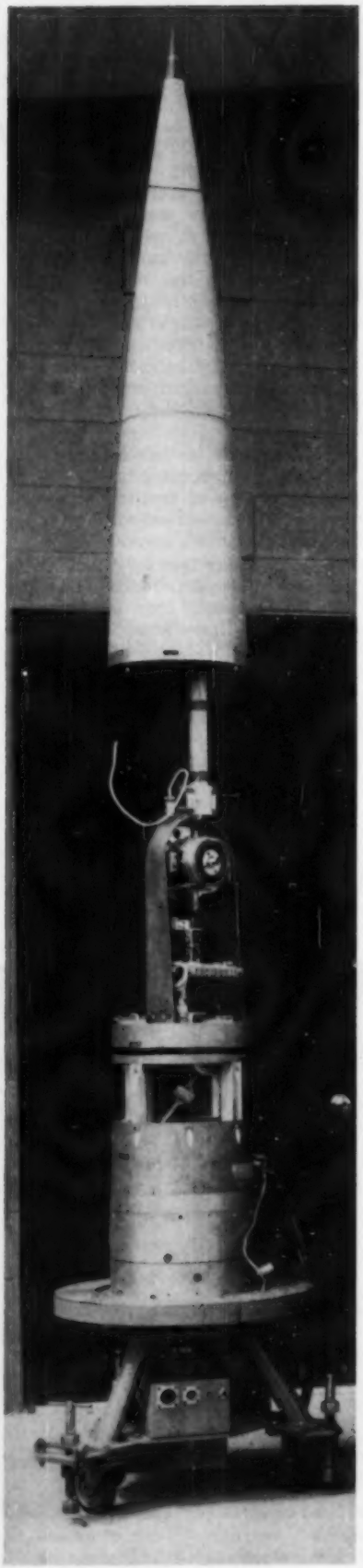
LEFT: *Drilling holes in aft section of Minuteman first stage. Accuracy depends on relationship of blast ports, geometrical center of case, other factors.* **RIGHT:** *Trace-machining aft closure—a job done by subcontractors.*

space systems

First Details of OAO No. 3 Experiment

Princeton - directed project will collect data by rocket to help determine satellite payload; test shot this week

by Charles D. LaFond



FIRST TEST of Aerojet-General attitude control system used in Aerobee rocket probes for developing astronomical satellite instrumentation will be attempted again this week. An earlier NASA launching attempt in March failed. Here is view of sun-seeking control system developed by Ball Brothers to check out Aerojet's control system.

FIRST instrumented probe in the stellar-ultraviolet radiation study for National Aeronautics and Space Administration is scheduled for May 1, 1962.

Each of three *Aerobee 150A* sounding rockets to be used in the initial program will carry a newly developed, very accurately aimed spectrometer. The equipment tests and the data recorded will provide early information for a follow-on UV-satellite study in late 1965. This will be the third experimental vehicle in the Orbiting Astronomical Observatory program.

Both the rocket probe study and the *OAO No. 3* project are under the direction of Professor Lyman Spitzer, Jr., Princeton University Observatory.

The initial rocket-study contract awarded to Princeton by NASA in October, 1960, reportedly totals "several hundred thousand dollars." The ultimate *OAO* project is funded by both NASA and Air Force for an undisclosed amount.

Preliminary work leading up to the initial contract was performed by Princeton with University funds.

• **New attitude control**—The *Aerobee* rocket to be used in the future stellar probes will carry a highly advanced attitude or pointing control and de-spin systems.

Since the rocket will be used as a test bed for developing many of the astronomical experiment instrumentations for the *OAO* program, three-axis stabilization is essential.

The 44-lb. control system was developed for NASA by Aerojet-General Corp. in Azusa, Calif. It is a 2-gyro-referenced, inertially programable system using cold-gas-jet reaction for control. The pair of free gyros—one for pitch and roll, one for yaw—serve as the key inertial sensing elements. Up to five spatial targets can be programed for each flight.

In the control system, pitch and yaw jets and solenoid-actuated valves are located in the tail cylinder, about the sustainer nozzle. Components for roll control and de-spin are installed with guidance intelligence sub-systems in a rocket nose extension, approximately 6.5 in long. Helium will be used in the reaction units.

Six sets of valves and nozzles will provide bi-directional control about each axis. One set of roll nozzles are used for de-spinning the vehicles after burnout—51 seconds after launch and at roughly 25 miles altitude.

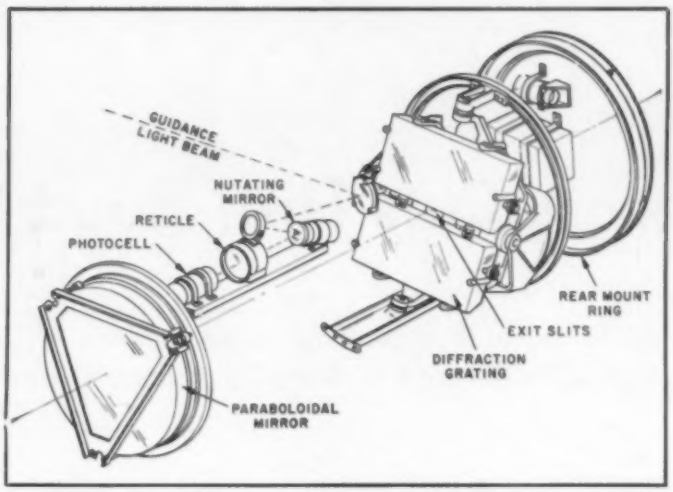
• **Another test due**—The two-stage vehicle will be launched this week in another attempt to check out control. First try failed last March.

Again the vehicle will have a nearly vertical trajectory. Maximum expected velocity is 6100 ft./sec. Its nearly 200-lb. payload will reach a peak alti-

tude of about 135 miles.

Instrumentation in this next shot will probably include units for measuring solar-flux in two spectral regions. These will be centered at about 2200 and 2600 Angstroms with a 100-200A bandwidth. Sensors are two photoemissive cells employing cesium - telluride cathode and appropriate optical filters.

A second experiment also will encompass measurement of energy in space. This will be a detector for obtaining data on the energy and distribution of gamma rays in the 0.1 and 1.5 million electron volt region.



UV SPECTROMETER and fine-positioning optical system used to align the diffraction grating. Developed by Perkin-Elmer for Princeton University Observatory, it will be carried in Aerobee 150A rockets for high-altitude stellar study.

Both experiments are considered secondary in importance to the testing of the attitude control system.

Included in the payload will be a tracking solar-aspect sensing system. Developed by Ball Brothers Research Corp., Boulder Colo., the sun seeker will be used to check out the Aerojet attitude control package. The device will be aligned to the control system axes and provide a means for measuring the angle between the solar vector and the longtitudinal axis of the rocket. it supplies both a fine and coarse alignment.

In case of primary system failure, a back-up for the solar-aspect sensing system will be included. This will consist of two magnetometers for sensing orientation to the earth's magnetic field.

• **Spectrometric study**—Next May, the first spectrometric measurements of hot-star ultraviolet radiation will be attempted.

The instrument to be used is currently being built for Princeton by Perkin-Elmer Corp., Norwalk, Conn.

In less than 5 minutes, at an altitude of 62-143 miles, the spectrometer will scan wavelengths from 1000 to 3000 Angstroms at approximately 30A/sec. Resolution will be about 2A.

The lightweight, low-power system, according to P-E, is designed for maximum simplicity and reliability. The complete package will measure 14 in. dia. x 30 in. long.

The first star selected for analysis is Alpha Birginis (Spica).

If all goes well with the attitude control, UV radiation from Spica will enter the system through an aperture in the rocket cone. Since the light source is stellar, radiant energy will arrive at the spectrometer already collimated.

The light passes through a diffraction grating (see drawing), and is then focused on a pair of photomultiplier - detectors, each scanning about 16A/sec. simultaneously. Photon-count signals are then amplified and telemetered to the ground receiving station for recording.

Accuracy of the Aerojet attitude control, according to Dr. J. Rogerson, assistant project director at Princeton, is designed to at least ±1.5 degrees. The P-E spectrometer, however, will have its own line positioning capability. It will permit a grating alignment normal to the incoming light to an accuracy of better than ±10 sec. of arc.

The fine adjustment system is a two-axis type using a simple but accurate rotating-image technique. Locked in place during powered flight, it is activated when the star under study is acquired.

Light is reflected by a mirror (mounted with the diffraction grating) to a rotating mirror, then directed through a reticle. Segmented into a "sun-burst" pattern, the reticle breaks up light passing through it according to amount and direction of position error.

This modulated light is focused on a phototube. Data are converted to error signals by a frequency-modulated discriminator and resolver. Error signals fed to a servo system are used to adjust the axes of two spectrometer gimbal ringmounts and thus position the diffraction grating.

Results of these early rocket studies will help determine type, size, and accuracy of future instrumentation which must be developed for *OAO No. 3.* ⌗

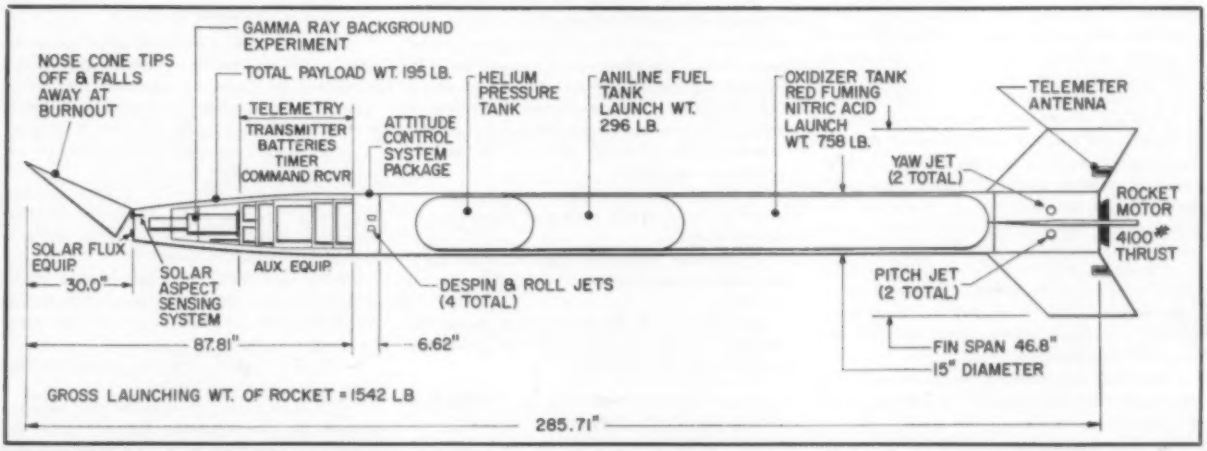


DIAGRAM OF AEROBEE 150A instrumentation configuration for testing a new attitude control system and for measuring solar flux and gamma-ray energy levels in space. NASA expects to launch the vehicle this week.

NRL Process Cuts Fire, Flood Damage

Cleaning technique has already saved millions of dollars in refitting burned carrier and is changing military's 'scrap it' policy

by William Beller

A NAVY-DEVELOPED chemical process is pointing the way to salvaging instruments and equipment usually considered lost when a factory is swept by fire or flooded.

The process has recovered several million dollars worth of electronic and electrical apparatus damaged by sea water, fuel oil and smoke during a fire on the carrier USS Constellation last December. Nearly all the communications and fire-control equipment not actually burned was fully reclaimed and put back into service.

Some users are so enthusiastic about the process that they are suggesting outfitting trailers which would rush to disaster areas to begin salvage operations.

• **100% loss**—When electronic or electrical gear is soaked with water—especially sea water—military doctrine has been to scrap it. Experience showed that when such equipment was "rehabilitated" its reliability was so low it could not serve a military mission.

It is still common practice to declare useless the electronics in "dunked" aircraft and in missiles aborted over water.

Also, because the reliability and accuracy of communications and radar equipment is so quickly undermined by salt spray aerosols—which are part of the environment aboard ship or at coastal locations—the electronics must be either carefully and expensively protected or frequently replaced.

In such instances of possible corrosion and water damage, the Navy process has resurrected military equipment with almost incredible effectiveness. Cleaners get rid of corrosion, fuel oil, soot and even some "varnish"; then a water displacer rapidly and actively chases the water from all the surfaces and interstices of the equipment.

In a graphic demonstration of the water displacement action, a ball of steel wool is first immersed in water. Then it is removed and sprayed with the water displacer. If conditions are right, in a few moments a clump of water drops out of the steel wool, which except for a protective coating is left bone dry.

When the USS Constellation damage was first surveyed, it was estimated that it would take a year to put the carrier back into service. This included the time it would take to replace most of the

First Aid for Salvaging Electrical, Electronic and Mechanical Equipment

BEFORE REMOVING any equipment from fresh or sea water be sure that preparations have been made to proceed immediately with salvage operations. If the equipment cannot be cleaned immediately, it should be flushed with fresh water and thoroughly sprayed with the water-displacing fluid at the earliest possible moment.

If the only surface contamination is fuel oil or similar material and sea water, the equipment may be flushed off with fresh water and carried immediately into Step 1 below.

If severe tarnishing or corrosion is encountered on small areas of the equipment, the corrosion products may be removed by a treatment of a minute or less in an ultrasonic bath containing inhibited sulfamic acid solution. This should be followed immediately by a fresh-water rinse, an alkaline neutralizing bath, and a final flushing with fresh water. The equipment should be carried immediately into Step 1 of the salvage procedure to remove the final traces of the stronger cleaning agents used in the auxiliary treatment.

Heavy sludges and greases may require the use of alkaline cleaners such as polyphosphates or silicates before Step 1.

Step 1. *Spray the exterior of the equipment thoroughly with the cleaning emulsion to remove as much contaminant as possible. Flush the equipment with fresh or sea water. If access can be gained to the interior of the equipment, spray the interior thoroughly, then flush it with water. If the construction of the equipment prevents access to the interior, disassemble and spray the interior thoroughly, then flush with water.*

Step 2. *After most of the oily contaminant has been removed by the flushing process, the last traces of contaminant and sea water can be removed from the equipment by subjecting it to the cleaning emulsion in an ultrasonic cleaning tank. This treatment is particularly effective in removing contaminants from crevices and narrow clearances. The ultrasonic cleaning treatment is carried out as follows:*

a. Disassemble the equipment as far as necessary to gain ready access of liquid to all remote locations.

b. Immerse the parts in the tank of an ultrasonic cleaning apparatus containing the cleaning emulsion.

c. Flush with fresh water; then repeat the ultrasonic treatment using fresh water to remove excess cleaning emulsion.

Step 3. *Blow as much water as possible from the equipment with clean compressed air.*

Step 4. *Spray all parts of the equipment with the water-displacing fluid. After spraying, allow 20 minutes for the water-displacing fluid to penetrate, displace and combine with the water remaining in the equipment.*

Step 5. *The residual mixture of water and water-displacing fluid should be evaporated in an oven or by hot air.*

If there is no fuel oil or lubricant contamination, omit Steps 1 and 2 and start the salvage procedure as indicated in Step 3.

Mechanical equipment is ready for operation after a thorough lubrication. After starting any equipment it should be operated for several hours under no load or very light load to secure gentle internal heating to complete the drying.

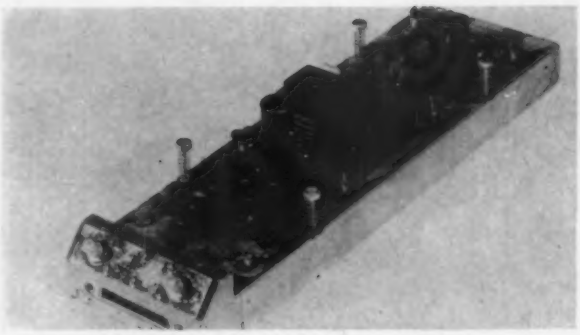
The following precautions should also be observed in all salvage operations:

—Journal bearings—remove waste packing in bearing chambers, clean as directed for other equipment above, add new packing, and saturate with suitable lubricant.

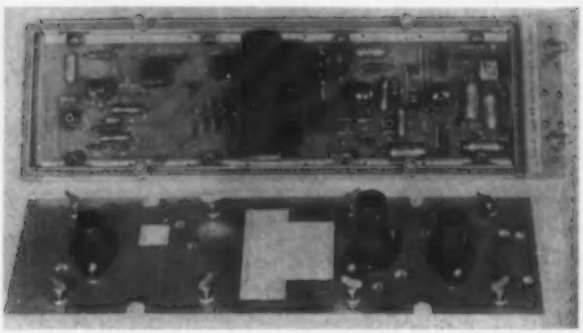
—Ball and roller bearings—remove grease either by disassembly and cleaning or by forcing new grease through bearings until all old grease has been displaced.

—Carbon brushes—replace carbon brushes in generators and d-c motors.

—Contact points in switches and relays—remove the rust-inhibiting film left from the water-displacing fluid by wiping joints with lintless cloth soaked in naphtha solvent or ethyl alcohol.



BEFORE: *Frequency converter heavily damaged by fire.*



AFTER: *Interior view shows thoroughness of cleaning.*

water-damaged, soot-and-oil-covered electronic and electrical gear.

• **Assembly-line cleaning**—Chiefly because of the cleaning process used on this gear, the carrier is expected to sail five months sooner. The process was in assembly line operation earlier this year at the New York Naval Shipyard in Brooklyn.

Components, racks of equipment and even consoles entered the line water-logged and smoke-blackened—and exited glisteningly clean and ready to function after minor replacements and adjustments.

In this assembly-line process, the equipment is first flushed out with fresh water. If necessary, it is ultrasonically treated with an aggressive cleaner to remove adherent particles. Then it is either bathed in an ultrasonic tank containing a Navy-developed cleaning emulsion or sprayed with it. This emulsion removes mobile contaminants such as fuel oil and smoke residue as well as sea water and sea-water corrosion products.

Next, the equipment is thoroughly flushed with water—either ultrasonically or by spray—to remove the cleaning emulsion and any traces of salt.

After flushing, the bulk water is blown away by clean compressed air. The water still remaining is physically pushed aside by a spray of water-displacing solution, which also deposits a thin anti-corrosion film. Any water that does remain—in deep crevices or within coil windings—combines with the water-displacing solution to form an azeotrope, which is a fluid having a lower boiling point than water. Thus, when an azeotrope evaporates, it takes the water with it.

Finally, the equipment is warmed either by an oven or hot air to evaporate the residual mixture of water and water-displacing fluid.

• **Water go away**—The two chemicals that make the process so effective—the emulsion cleaner and the water displacer—were formulated at the Naval Research Laboratory, with the support of the Navy's Bureau of Ships, in a program that goes back nearly 18 years.

At the time, a BuShips design engineer Earl Palmer wondered if something could be done to prevent the total loss of electrical equipment being raised from the ships sunk at Pearl Harbor. He suggested the problem to NRL chemist Dr. W. A. Zisman, already well known for his work in lubricants and surface chemistry. Zisman in turn brought his associate, H. R. Baker, into the project.

They started their study with a phenomenon that had been discovered more than a century earlier: if a little alcohol or some other polar volatile fluid is dropped on a wet surface, the water is pushed aside—but it flows back again.

The two chemists wanted an organic substance that would not only push water away, like alcohol, but would also keep it away.

After a scientific search of about a year, Zisman and Baker found a composition—butyl alcohol plus three percent basic barium dinonylnaphthalene sulfonate—that would successfully displace sea water. This was patented, and is being commercially produced under the trade name Spradri by the Perfecting Service Co., Charlotte, N.C.

Getting sea water out of electronic equipment is only one phase of the problem. When a ship's compartment is pierced—by collision or torpedo—the fuel bunkers are often ruptured. When the flooded compartment is drained, everything in it is found covered with a thick, tar-like blanket of black oil. Any attempt to salvage the equipment is usually considered doomed.

• **Displacing fuel oil**—Then in 1956, NRL revived the water-displacing problem—this time seeking an agent that would displace fuel oil.

Three years later, Baker and NRL chemist Dr. C. R. Singleterry reported the formulation of the water-based emulsion that was used to help clean the USS Constellation's gear.

The cleaning process is said to have no detrimental effects on electrical insulations, plastics, protective varnishes or adequate solders. Curiously, the process will often open a cold solder.

Dr. Singleterry points out that common sense is one of the main ingredients in the process. Salt-water-soaked equipment should be flushed out as soon as possible to prevent corrosion. Then the appropriate treatment should follow.

For the sake of economy as well as efficiency, the process should be varied with the degree and kind of exposure experienced by the equipment. If this is done, and if ordinary salvage precautions are taken, then sea water and bunker oil, fire and flood, will be claiming relatively smaller tolls of electronic and electrical gear. ⌗

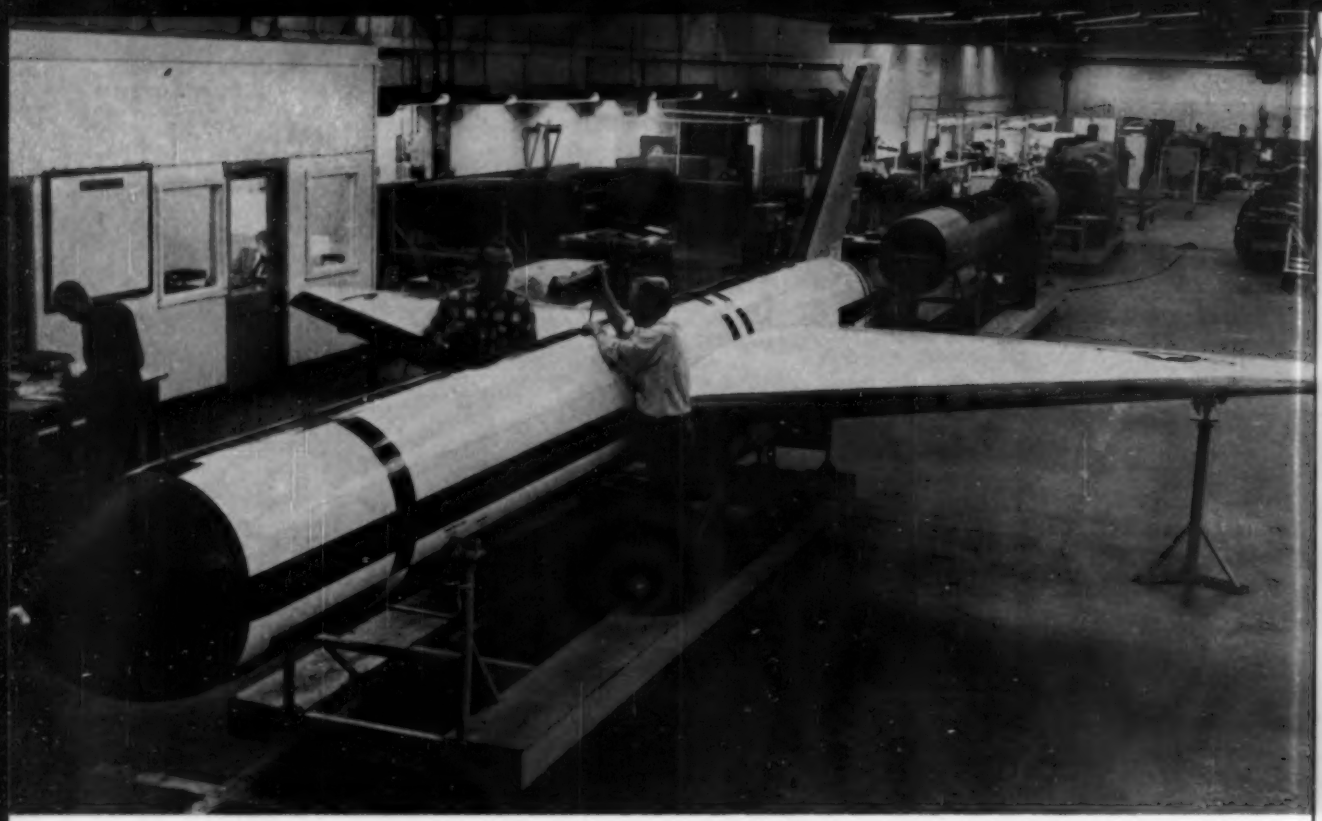
Cleaning Formulas

The cleaning organic-solvent concentrate is emulsified with an equal volume of water to give the following formulation:

44.5 vol-% 140 °F-flash-point aliphatic solvent
5.0 vol-% diesel fuel
0.5 vol-% polyethyleneglycol 400 monooleate S1006 (supplied by Glyco Products Co.)
50.0 vol-% water.

The water-displacing composition currently in use for salvaging equipment is formulated as follows:

93.75 vol-% 1-butanol
0.25 vol-% 2,6-dy-tertiarybutyl, 4-methyl-phenol
6.00 vol-% rust-inhibitor concentrate composed of 3.0 vol-% basic barium dinonylnaphthalene sulfonate and 3.0 vol-% naptha diluent to render the rust inhibitor more easily dispersed in the 1-butanol.



management

Fairchild's Future: Bidding for Big M

Reorganized and renamed for Missile/Space endeavor, the veteran firm will expand its successful drone work, step up R&D, sell more F-27's

by James Baar

HAGERSTOWN, MD.—Fairchild Stratos Corp., armed with new leadership and a new name, is now driving forward in an attempt to convert itself from a sick aircraft company to a robust member of the Missile/Space Industry.

The company is engaged in a carefully planned, three-pronged campaign of recovery:

—The expansion into new areas of its work on drone development, based primarily on the successful *SD-5* program.

—The expansion of its R&D capabilities in a number of key areas. This involves both the encouragement of in-house talent and the hiring of new talent.

—An intensified effort to sell its F-27 airplane to both military and civilian buyers.

The first two parts of this campaign are aimed at the new corporate goals toward which Fairchild is now moving. The F-27 sales drive is clearly directed at making the most of the past.

In its essence, the story of this campaign is the story of a corporation's bold fight for survival in the Missile/Space Age. The man at the center of this fight is Fairchilds' new, young president, Edward G. Uhl.

Uhl, the 43-year-old vice president and general manager of Ryan Aeronautical's San Diego Division and formerly vice president and general manager of the Martin Company's Orlando Division, was elected president of Fairchild last February. The election followed a complete shakeup of Fairchild's top management.

In 1960, expected sales of F-27's and new business in sufficient quantity failed to materialize. Gross sales slid $114 million in 1959 to $85 million—half of the sales in 1953. The year 1960 was the third straight year of decline for Fairchild; the fourth straight year barren of stock dividends.

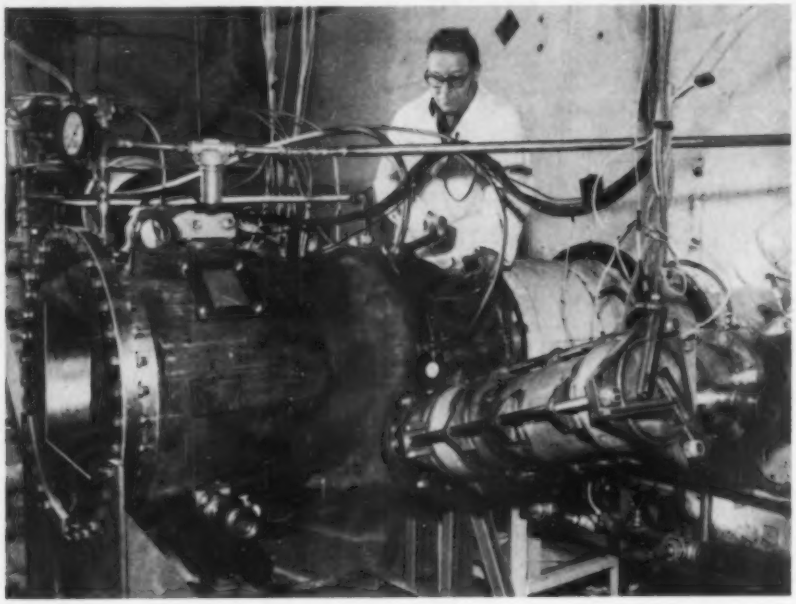
The company was a long way from its heyday during World War II: A long way from the production of the famed PT-19 primary trainer, the big C-82 and C-119 "Flying Boxcars."

• **Overhauling**—Last October the expected shakeup came. Sherman M. Fairchild, chairman of the board, assumed the job of acting president. J. H. Carmichael, president until then, resigned. Within a short time, almost all

UHL: "We'll get the people we want . . ."

LEFT: *Assembly line for Army's SD-5 reconnaissance drone, which provides biggest Fairchild contract so far.*

BELOW: *Closed-cycle Turbo-Compressor unit for Portable Nuclear Power Plant prepared for test run at Stratos Div.*



Missile/Space R&D Jobs

of the company's other top executive officers also resigned or were dismissed.

The board chairman then cut operating losses, sold off several properties and—as his report later put it—"restaffed top management with executive oriented by experience in those fields where business could reasonably be expected."

J. T. Dresher, vice president-finance at Hiller Aircraft Corp., became Fairchild's new vice president-finance.

DRESHER (LEFT) AND GRABBER.

John L. Grabber, director of contracts and counsel at Martin/Orlando, became Fairchild's new secretary and director of contracts.

Both Dresher and Grabber are young, highly energetic executives, typical of the sort of organization Fairchild is trying to become. Without question the most typical of this kind of executive is Uhl.

• **'Secret weapon'**—Fairchild's new president was graduated Phi Beta Kappa from Lehigh University. He majored in engineering and physics. During World War II, he served with Army Ordnance and rose from second lieutenant to lieutenant colonel before the defeat of Japan. In 1946 he joined the Martin Company as a research engineer.

Within 10 years, Uhl had become a vice president and established the Orlando Division of Martin. When he left Martin in 1959 to become vice president for technical administration at Ryan, Orlando had 6700 employes and a $175-million backlog of orders. A standing joke at Orlando was that among the division's secret weapons were the *Bullpup* and the Uhlpup.

Uhl sees an important distinction between the problems he faced at Orlando and the ones he is facing at Fairchild.

"When I went down to Orlando, we were trying to form a new beachhead," he said recently, sitting in his office at Fairchild's big Hagerstown plant. "We brought with us three programs: *Bullpup, Lacrosse* and Missile Master. We brought with us roughly 1000 people, about 300 of them engineers. We built from this.

"Here it is different. There is a lot of corrective action needed. The beachhead already has been formed. We have to straighten it out and build from that. And that's the challenge."

• **Hustlers invited**—Uhl sat casually in his shirtsleeves smoking a cigar. His crew haircut and frank, informal tones added to the easy-going impression that he gives. But that is only the surface picture. From behind it one can almost hear the sound of finely-tooled machinery clicking.

"I've been in business 20 years," Uhl said. "I've always had an impression of Fairchild which wasn't a very good one. Fairchild produced things and did it well. But, in general, the company was weak engineering-wise. My analysis is that this is the thing that has led to the company's near-demise. You just can't keep prospering on the work of other people."

Uhl paused and shook his head over the idea of producing what others create.

"We are going to build a sound technical capability at Fairchild in important, selected areas. We already have some top technical people in the organization who have never been encouraged. We will encourage and support them. We are going to bring in top technical people. These are the people around whom we will build our capability.

"I feel certain that we can get the people, the creative people, we are looking for. We will be offering two important things: the right kind of environment and an aggressive management. There are many people of the kind we want who are frustrated now in other organizations when they look up at the crusted layers above them. We are ready to build around this type of man."

Uhl smiled.

"We'll get the people we want when the word gets around that, if you really have an idea and a little hustle in your tail, go to Fairchild."

• **Beef-up by division**—Fairchild's new technical capability is being built up at four divisions that were kept in

(Continued on page 41)

Faster Numerical Control Programing

'Autopromt' language system made by IBM with help from United Aircraft is slashing milling time as well

A NEW COMPUTER language has been devised to cut the lead time in programing numerically-controlled machine tools for cutting complex three-dimensional parts.

The development by IBM's Data Processing Division with an assist from United Aircraft Corp. Research Laboratories is expected to bring about a wider use of this type of machine tool—already employed in the missile/space industry for solid motor aft closures and other difficult parts.

IBM's Autopromt (Automatic Programing of Machine Tools) allows the user to describe the surfaces of the three-dimensional shape to be milled rather than making him specify each path the tool must follow—a procedure which sometimes has meant compromises in tolerances which even extended to the design of the part.

Autopromt, moreover, is designed to make numerical control feasible in limited run production of such items as development models and in complex dies or matrices.

• **Operational procedure** — Autopromt is programed by a series of English-like statements written by an engineer working from a drawing.

He describes each of the constituent surfaces of the shape to be machined, defines the relationships of these surfaces to each other and specifies the machining requirements such as tolerances and tool size. This source program is punched into cards and fed into a computer.

The Autopromt processor program is also fed into the computer for storage in its core memory. This series of more than 30,000 instructions enables the computer to generate automatically from the source program the tool paths necessary to operate the numerically-controlled machine tool.

Under control of the processor program, the computer translates the Autopromt language into suitable computer codes, simulates within itself the surfaces and boundaries to be milled and then calculates the detailed tool travel instructions for each machining region.

The computer then edits these tool travel instructions according to the special requirements of the numerical control equipment being used. This editing is performed by an auxiliary program also stored in the computer's memory. Post-processing is not an integral part of Autopromt because it takes into consideration features peculiar to a particular machine such as chip-removal mechanisms or multiple tool heads.

Characteristics such as overshoot and rate of turning a corner are also handled by the post-processor. Autopromt is written for compatibility with various types of post-processors.

The final output from the computer, the "object program," contains a complete set of numerical instructions to the machine tool. It is on magnetic tape but can be converted to perforated tape of punched cards if necessary.

The original object program can be retained on magnetic tape as a master which can be reproduced as needed for machining at one or more locations. Autopromt instructions can be utilized by any combination of numerical control devices and milling machines. Autopromt is written for IBM 704, 709 and 7090 computers.

Autopromt language consists of 110 English words such as *cone, cylinder, hyperbolic paraboloid, etc.* denoting shapes and surfaces. Words designating surface relationships such as *angle, axis point, intersection of, etc.* are also included. The English-like language is easier to read and write when a program must be checked or studied.

• **Grinding gearboxes**—The first firm to put the Autopromt into use also cooperated in its development. United Aircraft produced a gearbox cover for the S-64 helicopter developed by the Sikorsky Aircraft division.

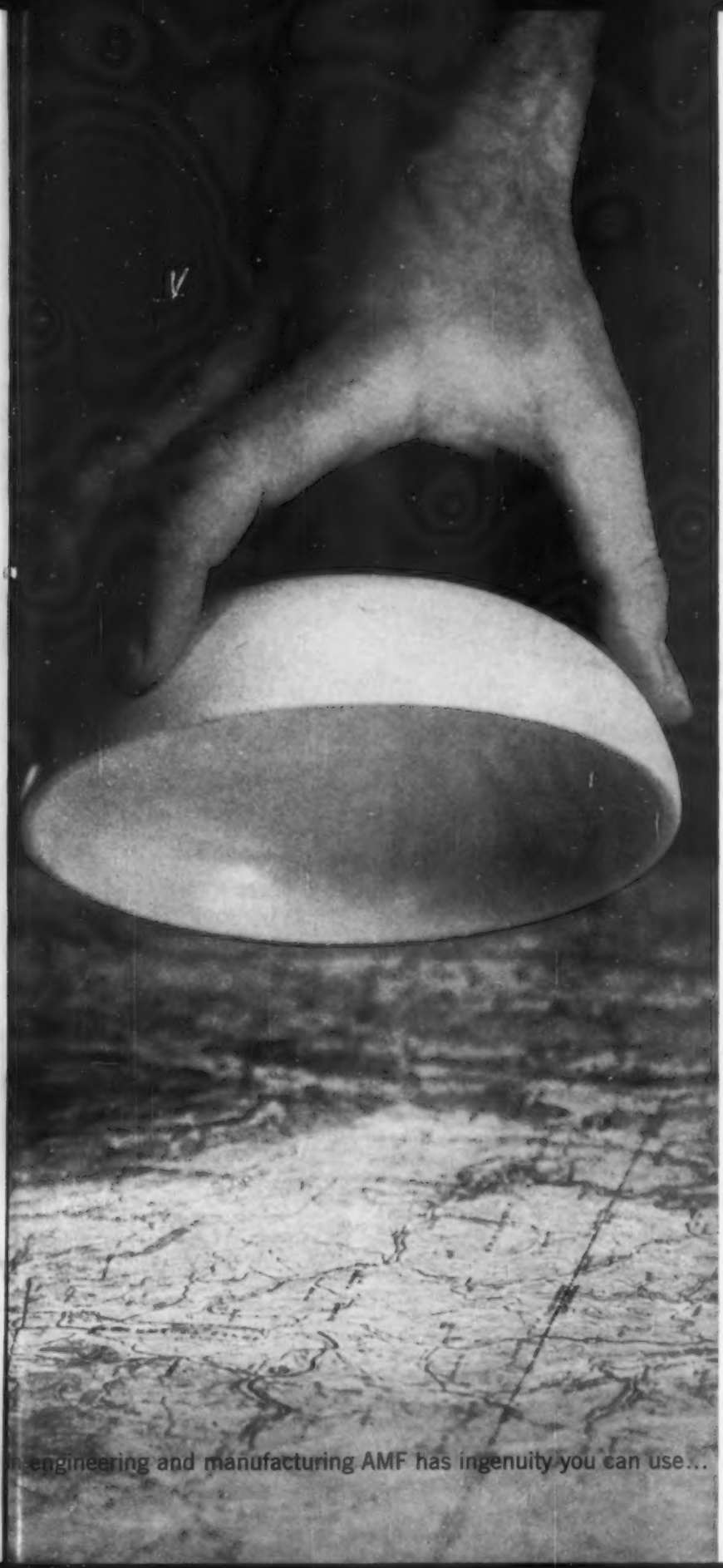
In conventional milling, it took a machine operator working directly from blueprints about three months to produce the gearbox cover. Using Autopromt on an experimental basis, lead time was reduced to about four weeks, with one week devoted to writing the input for the program and three weeks for running the program on the computer and correcting errors.

In normal operation, the lead time is expected to be only two weeks for a part of similar complexity.

Actual milling of each part required approximately 150 hours conventionally. This was cut to 40 hours using a numerically-controlled machine tool and Autopromt.

The machine tool used was a Pratt & Whitney Numeric-Keller equipped with an air-cooled Bendix Numerical Control System of modular plug-in construction. ⠿

GEARBOX COVER is cut by numerically controlled P & W Keller under instructions from IBM's Autopromt, which automatically generates paths the tool must follow.



He built the strongest roof in the world

This AMF engineer knows what it takes to shrug off megaton forces. He *had* to know because he designed the prototype atomic bomb shelter at Frenchman Flats, the only building that stood up under the force of the atomic bombs exploded there. Well, not altogether—a flange on the door *was* bent.

In order to design the shelter, he had to calculate the effect of the explosion on materials and structures. He had to know how the shock was transmitted through the earth's crust and what effect it would have on the shelter—from beneath as well as from above. And, after the dust of calculating had settled, he had the very practical problem of expressing the results in steel and concrete. He did so, successfully.

Single Command Concept

The solution of this first-time-in-history problem is one more example of AMF's resourcefulness.

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- *Undersea Warfare*
- *Radar*
- *Automatic Handling & Processing*
- *Range Instrumentation*
- *Space Environment Equipment*
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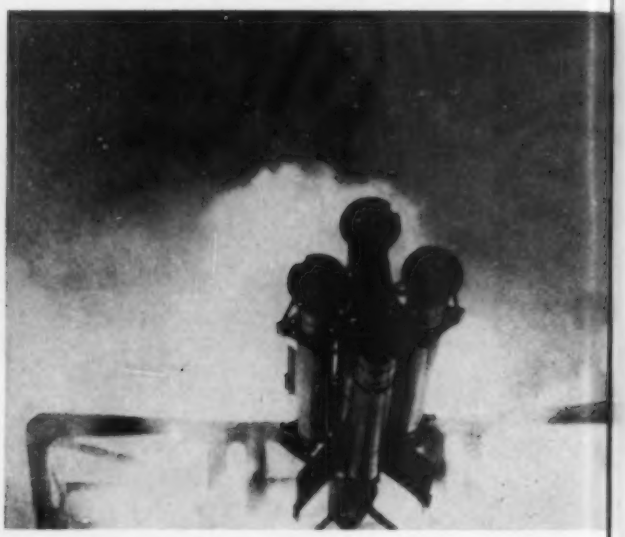
Seaslug Success Wins Okay for Mk-2

SEASLUG READY for launching from the quarterdeck of the HMS Devonshire, one of Britain's guided missile destroyers.



HMS GIRDLE NESS, Royal Navy Guided Missile Test Ship, fires a Seaslug in trials conducted in the Mediterranean.

by Bernard Poirier

THE BRITISH ADMIRALTY has authorized development of a longer-range Mark 2 *Seaslug*—even though *Seaslug Mk 1* will not be operational until next year—thanks to the highly successful trial firings conducted at sea and at the Woomera range in Australia.

The *Seaslug* system is unusual in that the missile undergoes a forced roll during the entire boosting phase and is purposely directed to the fringe area of the radar cone before being gathered by guidance along the center-line beam-riding path.

High scores against *Meteor* drone targets were highlights in recently concluded Mediterranean trials by the Royal Navy's 8580-ton Guided Missile Test Ship Girdle Ness.

The 19.5-ft. medium-range missile will join the shorter-range, low-level *Seacat* as standard armament on County Class guided missile destroyers (M/R, June 5, p. 19). The 5200-ton Hampshire and Devonshire have already been launched, and the Kent and London will enter the water this year.

Developers of the *Seaslug* weapon system are Armstrong Whitworth Aircraft (Hawker Siddeley Group), the Sperry Gyroscope Co., Limited, and the General Electric Co., Limited.

• **Proof of ruggedness**—To assure that specifications on ruggedness were met, the British Navy conducted special sea-going transfers of the vehicle, with boosters mounted, from the fast replenishment vessel Retainer to the Girdle Ness.

(In a tragic Viscount air accident over Rome in October, 1958, a *Seaslug* electronic unit fell 30,000 ft. After recovery, all functions but one met testing specs, despite bending and distortion of the package.)

The missile's guidance receiver contains about 100 electronic valves and 800 components. The company says "extensive use is made of printed wiring and individual sub-units are potted in resin." It adds that components recovered from vehicles fired at the Woomera range are often reused in subsequent tests.

The *Seaslug* will be mounted on the afterdeck. The *Seacat* will be located aft on the main deck, but not as far back as the *Seaslug's* radar dish.

• **Spin spreads variation**—The *Seaslug's* flight is divided into five phases—boost; roll-stabilization; gathering; guidance; and interception.

Four solid boosters lie close to the weapon's body with their nozzles angled outwards and sidewards. The sideward angle imparts a spin or roll to the missile, insuring that any variation in thrust among the boosters is distributed along the line of flight. Once the boosters fall away, missile velocity is maintained by a solid sustainer motor.

Before directional control can be applied the rolling motion must be stopped and the missile oriented correctly with respect to the beam. Deflection of all four control surfaces halts the motion; one pair of vertical fins stabilizes it for alignment by means of a free gyroscope reading.

At this point the missile is above the beam and on the fringe of the radar transmitting cone. High *Seaslug* response is required for "gathering" it on to the center beam, where the response of the control system is reduced.

From this point to final interception it remains aligned with the beam, allowing for corrections due to air turbulence. From before launch to detonation the radar commands the system. It locks on a target as soon as it is possible to be designated, and tracks it into missile range. Once the missile is fired, guidance and radar are mated through to the kill. ¤

Microdot Inc. Adds Projects and Products

Owen Lab. Products Added. Strain gage power supplies and control equipment produced by Owen Laboratories have been acquired by Microdot. The acquisition furthers Microdot's expansion in the instrumentation field, and provides strain gage conditioning equipment compatible with other existing Microdot products.

Power Oscillator Offered. As a result of its acquisition of Spectralab Instrument Company, Microdot is offering a line of power oscillators for laboratory use in the evaluation of power measuring devices, driving amplifiers, and other applications where higher power ratings are required.

Model 410 oscillator, shown above, offers a frequency range of 500 to 1050 mcs direct reading. Power range is 50 mv to 50 w. The unit measures 8″ x 11½″ x 19″ and weighs 45 pounds.

Martin Awards Contracts. Assignments for the development of precision temperature measuring systems for the advanced version of the Titan II missile have been awarded to Microdot by the Martin Company, Denver, Colorado. Solid state designs of sophisticated telemetry equipment for extreme environments will be utilized. The systems will be designed, tested, and produced in Microdot's San Diego Division.

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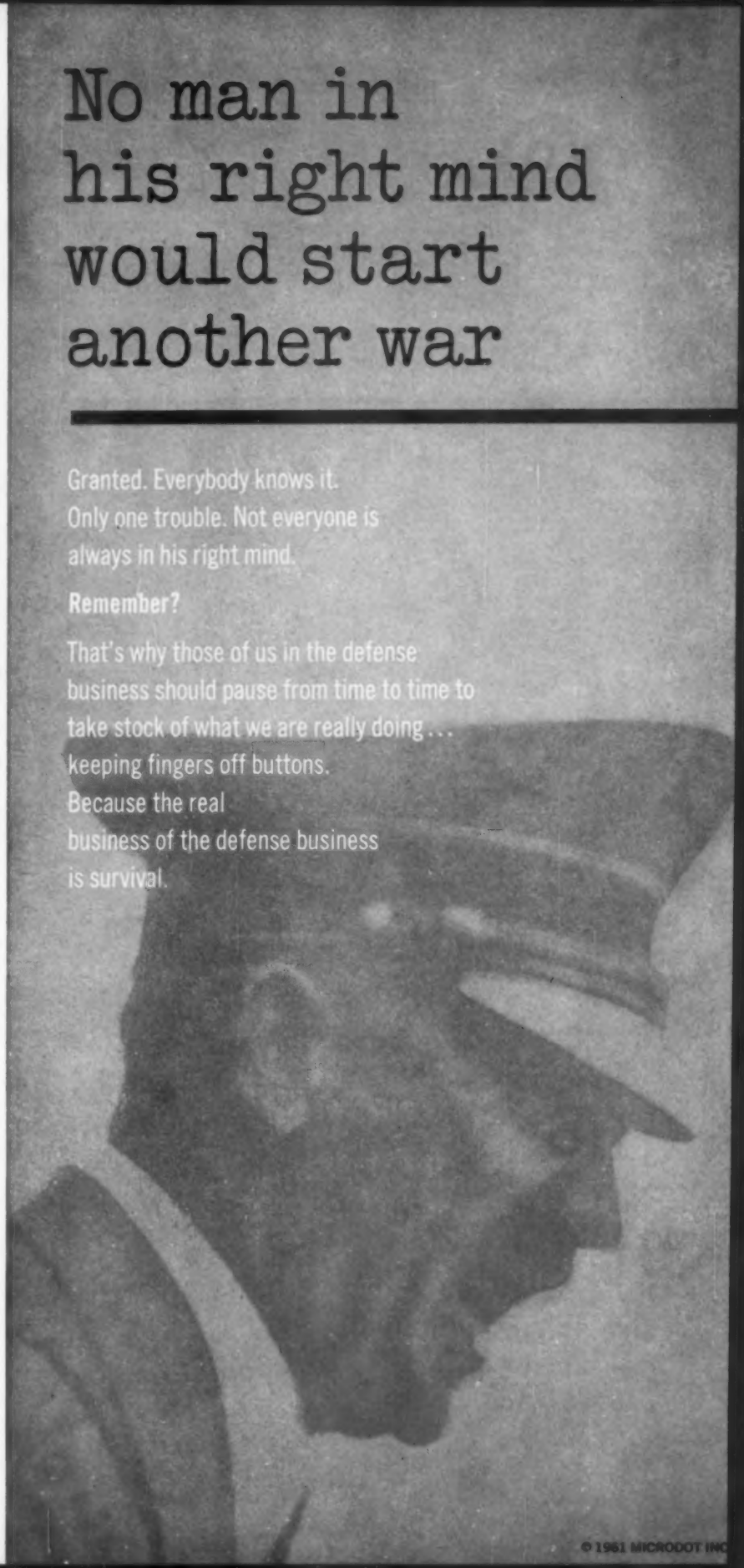
Only one trouble. Not everyone is always in his right mind.

Remember?

That's why those of us in the defense business should pause from time to time to take stock of what we are really doing... keeping fingers off buttons.
Because the real business of the defense business is survival.



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20% are new faces . . .

DOD Lists 100 Top Primes for 1960

MISSILE/SPACE contractors dominate the Department of Defense roster of the 100 top military prime contractors for calendar 1960.

In computing the totals, only government contracts of $10,000 or more are taken into account.

Twenty firms on the '60 list were not on in '59, and two of the firms included were formed by merger or acquisition of companies appearing in '59. Textron, Inc. bought the defense business of Bell Aircraft Corp., and Ling-Temco Electronics, Inc., bought and merged Temco Aircraft Corp.

Companies	Millions of Dollars
1. General Dynamics	$1,294.7
2. Lockheed Aircraft Corp.	1,124.3
3. North American Aviation, Inc.	964.1
4. General Electric Co.	944.7
5. Boeing Airplane Co.	867.1
6. United Aircraft Corp.	739.1
7. Martin Co. (The)	708.4
8. American Telephone & Telegraph Co.	501.9
9. Hughes Aircraft Co.	437.6
10. Raytheon Co.	374.2
11. Radio Corp. of America	364.8
12. Douglas Aircraft Co.	353.5
13. Grumman Aircraft Engineering Corp.	336.6
14. Republic Aviation Corp.	323.3
15. Sperry-Rand Corp.	318.0
16. International Business Machines Corp.	312.1
17. Newport News Shipbuilding & Dry Dock Co.	302.4
18. Bendix Corp.	274.3
19. Westinghouse Electric Corp.	269.5
20. General Tire & Rubber Co.	257.8
21. General Motors Corp.	214.0
22. Chrysler Corp.	199.5
23. Avco Corp.	193.2
24. International Telephone & Telegraph Corp.	188.3
25. Standard Oil Co. (New Jersey)	163.7
26. Northrop Corp.	158.0
27. Thiokol Chemical Corp.	140.1
28. Burroughs Corp.	122.7
29. Chance Vought Corp.	120.6
30. Hercules Powder Co.	118.8
31. McDonnell Aircraft Corp.	118.8
32. Pan American World Airways, Inc.	109.1
33. Philco Corp.	101.4
34. Thompson Ramo Wooldridge, Inc.	100.9
35. Collins Radio Co.	99.0
36. Standard Oil Co. of California	96.9
37. Minneapolis-Honeywell Regulator Co.	84.3
38. American Machine & Foundry Co.	83.9
39. General Precision Equipment Corp.	83.0
40. American Bosch Arma Corp.	82.4
41. Massachusetts Institute of technology	80.9
42. Garrett Corp.	80.8
43. Textron, Inc.	78.1

An Opposite and Equal Reaction

ANCHOR NEEDED—Problems of using tools in weightless, frictionless state are vividly illustrated in this time-sequence photo taken in a North American Aviation Space and Information Systems Division study. Compressed air forms layer between stool and platform, creating frictionless state. Man sends himself spinning away when he tries to perform simple repair.

Companies	Millions of Dollars
44. Ling-Temco Electronics, Inc.	$76.9
45. Kaiser-Raymond, Macco-Puget Sound	75.4
46. Texaco, Inc.	74.3
47. Curtiss-Wright Corp.	67.1
48. Goodyear Tire & Rubber Co.	64.3
49. Food Machinery & Chemical Corp.	62.6
50. Continental Motors Corp.	62.4
51. Ryan Aeronautical Co.	56.2
52. Du Pont (E.I.) de Nemours & Co.	55.4
53. Olin Mathieson Chemical Corp.	53.4
54. Kiewit (Peter) Sons' Co.	52.7
55. General Telephone & Electronics Corp.	52.6
56. Shell Caribbean Petroleum Co.	51.7
57. Merritt-Chapman & Scott Corp.	49.2
58. Laboratory for Electronics	48.9
59. Socony Mobil Oil Co., Inc.	47.1
60. Marquardt Corp.	46.3
61. Bethlehem Steel Corp.	45.3
62. Lear, Inc.	43.7
63. Magnavox Co.	43.5
64. Northern Pump Co.	43.1
65. Mason & Hanger-Silas Mason Co., Inc.	42.6
66. Sanders Associates, Inc.	41.9
67. Todd Shipyards Corp.	40.0
68. Motorola, Inc.	38.0
69. Kaman Aircraft Corp.	36.5
70. Ford Motor Co.	36.2

Companies	Millions of Dollars
71. Ingalls Iron Works Co.	$ 35
72. Richfield Oil Corp.	34.1
73. System Development Corp.	32.8
74. Union Carbide Corp.	32.0
75. Universal American Corp.	31.3
76. Fairchild Engine & Airplane Corp.	30.8
77. Continental Oil Co. (Delaware)	29.9
78. Goodrich (B. F.) Co.	29.9
79. Standard Oil Co. (Indiana)	29.5
80. Gulf Oil Corp.	29.5
81. Firestone Tire & Rubber Co.	29.4
82. International Harvester Co.	29.0
83. Vitro Corp. of America	28.7
84. Gilfillan Brothers, Inc.	28.6
85. Cook Electric Co.	28.3
86. Air Products, Inc.	27.8
87. Sinclair Oil Corp.	27.8
88. Jones-Teer-Winkelman	27.8
89. Johns Hopkins University	27.7
90. Utah-Manhattan-Sundt	27.3
91. Litton Industries, Inc.	27.2
92. Hallicrafters Co.	26.9
93. Cities Service Co.	26.2
94. Morrison-Knudsen Co.	26.1
95. States Marine Corp.	26.0
96. A R O, Inc.	25.9
97. Hazeltine Corp.	25.0
98. Union Oil Co. of California	24.6
99. Western Contracting Corp.	24.2
100. Sunray Mid-Continent Oil Co.	24.1

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The Information Processing Center at Lockheed Missiles and Space Division is located in Sunnyvale, California, on the San Francisco Peninsula. Essential to Lockheed Missiles and Space programs is the mechanism necessary to provide sophisticated and efficient test data processing and analysis, scientific computing, and administrative information processing. The Center is one of the largest and most advanced information analysis and computer facilities in the country. Equipment includes three IBM 7090's, three Control Data Corp. 1604's, and a variety of advanced peripheral equipment including a number of IBM 1401 Data Processors.

See reverse side for available positions

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ANALOG COMPUTING

Set-up and operation of electronic Analog Computers to solve problems concerned with mathematical models and physical simulations.

Provide consulting services to other organizations and perform mathematical analysis in the solution of applicable problems.

DATA PROCESSING AND ANALYSIS

Project liaison to establish data requirements and information acquisition system—data processing system compatibility.

Development, maintenance and operation of data processing systems which dictates computer programming requirements and relates operation of conversion system to computer system in providing engineering analyses.

Operational evaluation of instrumentation, acquisition, and processing systems. Automation of processing and analysis techniques.

COMPUTATION CENTER

COMPUTER SYSTEMS INTEGRATION

Integration of programming and operating systems, digital computers and related equipment, operational data, training, and publication within the Computation Center.

ADMINISTRATIVE INFORMATION DEVELOPMENT

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SPACE VEHICLE PROGRAMMING

Analysis, programming, and programming systems to monitor, control and analyze space vehicles.

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o. Years | Position or type of work

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me address_____

y & State_____ Phone_____

Highest degree_____ Year awarded_____ Major_____

Experience:

No. Years | Position or type of work

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Name (print)_____

Home address_____

City & State_____ Phone_____

Fairchild . . .

(Continued from page 31)

the reorganization: The Aircraft and Missiles Division at Hagerstown; Electronics Systems Division (formerly Astrionics) at Wyandanch, N.Y.; Stratos Division at Bay Shore, N.Y.; and Aircraft Service Division at St. Augustine, Fla.

The Aircraft and Missiles Division was hit hardest in recent years by the decline in Fairchild's aircraft manufacturing. Employment at the Hagerstown plant fell in a few years from 8000-to-10,000 down to about 2000. The plant's biggest jobs today are assembling F-27's, *SD-5's*, wing parts for B-52 jet bombers and large radar antennas. Company plans call for early future expansion to take place here.

Most of the work on the *SD-5* drone takes place at the Electronics Systems Division. Other contracts include "polarized" antenna work for the Air Force.

The Stratos Division is currently the heart of much of Fairchild's technological capability. It is providing ground support equipment for a number of missiles including *Mauler* and *Skybolt* and airborne equipment for *Titan, Atlas* and *Mace*. Stratos' Western Branch plant at Manhattan Beach, Calif., is noted for proprietary ASW equipment.

Only last week, Stratos announced the purchase of Tribo-Netics Laboratories, of Vermilion, Ohio, a specialist in gas-lubricated bearings.

The changing of the corporation's name last month from Fairchild Engine and Airplane Corp. to Fairchild Stratos is clearly much more in line with the capabilities of the four divisions and the corporation's new goals. The name Fairchild was retained to represent experience in the aviation industry dating back to the years just after World War I. Stratos represents the future.

• **Selective kissing** — Fairchild's plans to build up its technical organizations are the basis of its hopes to expand its share of the missile/space R&D market.

"We see our future in taking prime R&D contracts in the missile/space field," Uhl stated flatly. "I hear many complaints, but I don't see any reason why you shouldn't make a good profit doing R&D work. If the people who complain think it is such a lousy business, why don't they get out? I think it is good. I want to get in.

"It's a matter of making the right choices. I think you have to be very selective. You can kiss all the girls in this business."

"The cream is off the big missile

(Continued on page 43)

CALLERY PROPELLANT BRIEFS

Workmen check bulk containers of pentaborane before shipment to Air Force from Callery's Muskogee, Okla., plant.

Worker Training and Sound Engineering make TONNAGE PENTABORANE AVAILABLE NOW

Pentaborane, like most of the other highly reactive chemicals in propulsion systems, takes respectful handling by properly supervised and trained workers. Callery has been able to bring the tremendous potential of the boranes to the propulsion foreground through the use of sound design and construction principles. We are shipping tonnage quantities of pentaborane from Muskogee under an Air Force contract.

The Callery-developed high temperature data in the next column may provide you with some new directions in your propellant systems design. Other data on pentaborane is available covering density, dielectric constant, heat capacity, solubility, surface tension, vapor pressure and viscosity vs. temperature. Write us for specific details on data and handling procedures for pentaborane.

DENSITY OF LIQUID B_5H_9 vs TEMPERATURE

Temp. (°C)	Observed Density (g/ml)
60	0.5866
70	0.5780
75	0.5741
80	0.5688
90	0.5604
95	0.5561
100	0.5522
110	0.5431
115	0.5389

SOLUBILITY OF NITROGEN IN LIQUID B_5H_9

(Total Pressure 1000 ± 7 psig)

Temp.	Solubility		
(°C)	IGPP(1)	MR(2)	H(3)
30	68.7	0.0559	8.14×10^{-4}
50	68.4	0.0607	8.87
70	67.9	0.0644	9.48
100	65.9	0.0711	10.79
129	62.8	0.0722	11.50
150	59.6	0.0779	13.07

(1) IGPP, Ideal Gas Partial Pressure (atm. Abs)
(2) MR is moles gas/ mole pentaborane
(3) H is MR/IGPP

Callery Chemical Company, Defense Products Department

Headquarters: Callery, Pennsylvania. Telephone Evans City (Pa.) 3510
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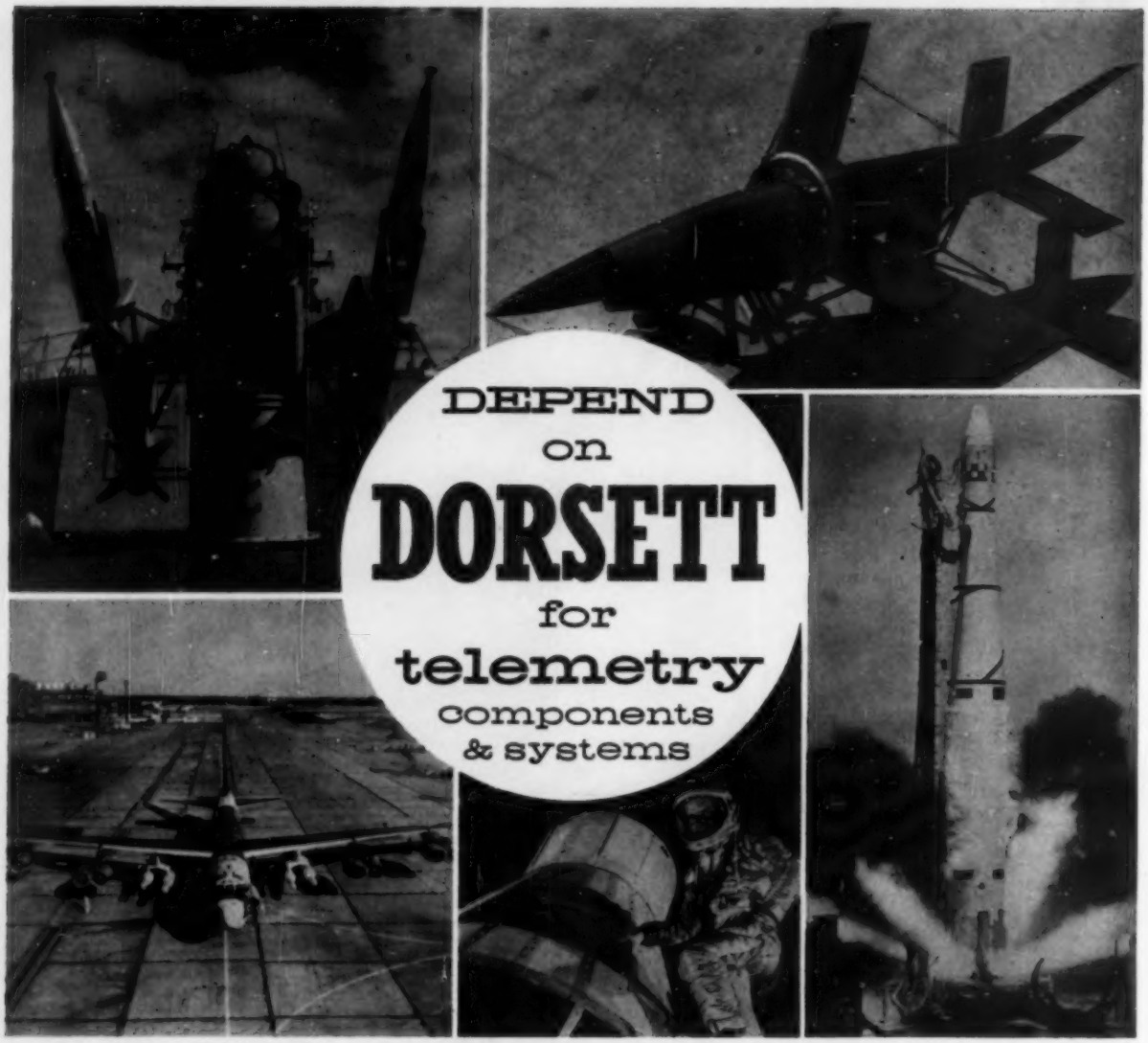

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(Continued from page 41)

bottle," he said. "The missile programs to come will be the tactical ones. I don't see why we shouldn't take a crack at them. Also someone is going to replace someday missiles that we have like the *Bullpup*.

"Fairchild already has a very good missile in the *SD-5* drone. It could be a work horse. It could be made to carry cargo. It could be a tactical missile. Our first new series of proposals involve expanding our drone capability.

"Antennas are another area where we already are at work. And there are others. I was pleasantly surprised to find what technical capability Fairchild already has. At the Stratos Division, for instance, there are good environmental test facilities, and electronic facilities."

• **Selling F-27**—As for the F-27, Uhl expressed new confidence in selling the plane to the military services.

"The F-27 can do a lot of very important jobs. This expansion of limited war forces makes the need for aircraft of this type even greater. Take a country like Laos. The DC-3 is the only way to provide support. But the DC-3's are getting older and older. And the F-27 can do the job—and more."

Uhl's expectation of military sales for the F-27 has yet to be given much credence outside of Fairchild. The military services have not been enthusiastic. And future sales to airlines will be much influenced by the services' decisions.

Meantime, Fairchild has sold nearly 60 F-27's to 13 commercial airlines from Hawaii to Turkey. It also has sold 29 to private corporations. The plane is an operational success, but for various other reasons it has not been accepted by the Pentagon.

Unquestionably an important one of these reasons has been some strained relationships with the military services in the past. The improvement of the company's relationship with the government is one of the new management's primary concerns.

But, whatever the fate of the F-27, some of Uhl's expectations in other areas already are being proven out.

The Army Signal Corps has awarded Fairchild a $7.8-million contract for development of a "multi-purpose" version of the *SD-5*. It will be called the *SD-5 (XE-2)*.

To date, the *SD-5* program is Fairchild's biggest contract. It has totalled about $60 million since it was started in 1957. The new contract was considered a highly favorable omen.

As Uhl put it:

"I don't feel ashamed with what we have technically today at Fairchild. In many areas we already can compete with the 'bigs.'" ⌗

GOING UP WITH RCA TITAN PROJECT

RCA Titan Project, Marysville, California, has a limited number of openings for experienced Missile Engineers willing to step *up* to RCA. Openings exist at all levels in these engineering areas:

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If you are a qualified Missile Engineer and would like more information about the challenge and benefits awaiting you at the RCA Titan Project: (a) circle your professional area above; (b) check the items of information desired below; (c) attach a resume of your professional accomplishments to this ad and mail today.

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INDEX

ISSUES OF JAN. 2, 1961 THROUGH JUNE 26, 1961

With the following six-month editorial index, MISSILES AND ROCKETS *has adopted an easy-to-find alphabetical listing of major news and technical articles. Previously, indexes were broken down into major areas of interest. An index is published in the last issue of each six-month period.*

A

ADHESIVES. ADHESIVE TAKES HIGH HEAT AND SHOCK, *4/24/61, p. 40.*

AEROSPACE CORP. AEROSPACE AIMS TO TRIPLE TECHNICIANS, *2/27/61, p. 85.*

AEROSPACE INDUSTRIES. AIA'S COOK SEES NO CHANGE IN SALES, *1/2/61, p. 39.*

AEROSPACE INDUSTRIES ASSOCIATION. PRICE OF INADEQUATE MEASUREMENT STANDARDS; AIA-SPONSORED CONFERENCES FIND THAT LACK IS HURTING DEFENSE EFFORT, *2/6/61, p. 26.*

AIR FORCE. AF DRIVES FOR BIG SPACE ROLE, *by James Baar, 1/9/61, p. 11.*

AF'S PILOT SCHOOL LACKING SPACE TRAINER, *5/29/61, p. 80.*

McNAMARA RENEWS AIR FORCE DOMINANCE OF MILITARY SPACE, *3/13/61, p. 16.*

SCHRIEVER TELLS AAS OF COMING SPACE BLUEPRINT, *1/23/61, p. 18.*

AMERICAN ASTRONAUTICAL SOCIETY. SCHRIEVER TELLS AAS OF COMING SPACE BLUEPRINT, *1/23/61, p. 18.*

AMERICAN OPTICAL COMPANY. LASER, FIBER OPTICS TECHNOLOGIES JOIN, *by Charles D. LaFond, 5/8/61. p. 33.*

AMERICAN ROCKET SOCIETY. ARS, ASME MEET CONCURRENTLY IN LA, *3/20/61, p. 41.*

AT ARS SOLIDS CONFERENCE . . . CONSUMABLE CASE ROCKET DESCRIBED, *by Frank G. McGuire, 2/13/61, p. 35.*

A TEMPEST IN A SAMOVAR; EDITORIAL *by William J. Coughlin, 2/13/61, p. 50.*

AMERICAN TELEPHONE AND TELEGRAPH CO. AT&T AUTHORIZED TO USE TWO GIGACYCLE CHANNELS BY FCC, *1/30/61, p. 65.*

AT&T, GE FILE CONFLICTING SPACE COMMUNICATION IDEAS, *5/8/61, p. 16.*

COMMERCIAL SATELLITE GIVEN GO-AHEAD; FCC PREPARING TO GRANT EXPERIMENTAL CHANNELS TEMPORARILY TO AT&T, *by Jay Holmes, 1/9/61, p. 13.*

AMERICAN TELEPHONE AND TELEGRAPH CO. FCC NEAR CHOICE ON PHONE SATELLITES; AT&T GROUP VIES WITH GE AND OTHER MISSILE/SPACE FIRMS, *by William E. Howard, 6/19/61, p. 14.*

ANTIMISSILE MISSILES. FIRST PHOTOS OF NIKE-ZEUS ASSEMBLY, *1/2/61, p. 16.*

HOW TO KILL AN ICBM, *1/30/61, p. 30.*

NIKE-ZEUS NOW, SPECIAL REPORT, *by James Baar, 1/30/61, p. 26.*

NIKE-ZEUS; SPEED-UP OF MISSILE OUTPUT WOULD BE SIMPLE, *by William J. Coughlin, 1/30/61, p. 36.*

NIKE-ZEUS; TOUGH RADAR PROBLEMS ALREADY SOLVED, *by Charles D. LaFond and Hal Gettings, 1/30/61, p. 31.*

ZEUS SEEN AS ANTI-SATELLITE WEAPON AT MISSILE/SPACE CONFERENCE, *3/20/61, p. 14.*

ANTISUBMARINE WARFARE. AEC FUNDING CUT HITS SNAP 4 UNDERSEA POWER UNIT, *by William Beller, 3/6/61, p. 40.*

ASW COMMITTEE WINS G-D $10 MILLION IN CONTRACTS, *by William Beller, 5/1/61, p. 36.*

AIR WRAPPING MAY SPEED TORPEDOES, *by William Beller, 4/17/61, p. 26.*

NAVY GETTING SUB TARGET SIMULATORS, *by William Beller, 3/13/61, p. 28.*

SEISMOLOGY TAKES TO UNDERSEA WARFARE, *by Hal Gettings, 1/9/61, p. 28.*

SONOBUOY DETECTION POSES THREAT TO NUCLEAR SUBS, *by William Beller, 1/23/61, p. 38.*

UNIQUE FLEET OF ASW STUDY SHIPS URGED, *by Richard van Osten, 6/5/61, p. 32.*

ARMY. ARMY GETS NEW COMMUNICATION SYSTEMS, *6/5/61, p. 30.*

ARMY MAPS ORO REPLACEMENT, *6/5/61, p. 11.*

ARMY READIES HUGE TEST BUILDING [REDSTONE ARSENAL, HUNTSVILLE, ALA.], *1/16/61, p. 39.*

ARMY TO CONTROL RECONNAISSANCE PAYLOADS, *4/10/61. p. 15.*

McNAMARA REPORTED FAVORING ARMY-NAVY STRATEGY OF 'FINITE DETERRENCE' *by James Baar, 3/6/61, p. 14.*

NIKE-ZEUS BASES WOULD BE MANY AND SPRAWLING, *1/30/61, p. 49.*

NIKE-ZEUS MANAGEMENT IS ALL READY TO ROLL; ARMY-INDUSTRY HAS BEEN GEARED UP FOR A YEAR TO GO INTO MASS PRODUCTION, *by Frank G. McGuire, 1/30/61, p. 51.*

ASTROPOWER, INC. ASTROPOWER HEAD OUTLINES R&D PLANS, *1/2/61, p. 39.*

LEE HAS BIG PROPULSION PLANS FOR ASTROPOWER . . . M/R INTERVIEW, *2/13/61, p. 30.*

ATOMIC ENERGY COMMISSION. AEC FUNDING CUT HITS SNAP 4 UNDERSEA POWER UNIT, *by William Beller. 3/6/61, p. 40.*

ATTITUDE CONTROL. HOW CAN PILOT BEST CONTROL SHIP'S ATTITUDE? *by Charles D. LaFond, 3/6/61, p. 36.*

AUSTRALIA. AUSTRALIA'S MALKARA DEATH TO BUNKERS, *by Alan S. Hulme, 4/10/61, p. 38.*

BOOM IS ON AT AUSTRALIA'S WOOMERA RANGE, *by Bernard Poirier, 3/27/61, p. 42.*

AUTOMATION. MARTIN SHOWS ITS 'AUDIO-AUTOMATION', *3/13/61, p. 38.*

AUXILIARY POWER UNITS. SPACE IS NO PLACE FOR UNTRIED APU'S *by William Beller, 5/29/61, p. 74.*

B

BANSHEE PROJECT. BANSHEE HE BLASTS WILL PROBE NEAR SPACE, *by Richard van Osten, 3/13/61, p. 40.*

BERYLLIUM. NAVY FINDS BERYLLIUM TO BE INHERENTLY DUCTILE, *4/3/61, p. 15.*

BIOGRAPHY. COUGHLIN WILLIAM J. MEMO FROM THE PUBLISHER, *2/6/61. p. 9.*

GETTINGS, HAL. MEMO FROM THE PUBLISHER, *3/27/61, p. 9.*

GLENN, LT. COL. JOHN H., JR. THREE ASTRONAUTS PICKED, *2/27/61, p. 80.*

GRISSOM, CAPT. VIRGIL I. THREE ASTRONAUTS PICKED, *2/27/61, p. 80.*

HAYWARD, VICE ADM. JOHN T. HAYWARD NEXT CNO?, *3/13/61, p. 15.*

HERRICK, JOHN W. MEMO FROM THE PUBLISHER, *2/27/61, p. 7.*

HOWARD, WILLIAM E. MEMO FROM THE PUBLISHER, *3/13/61, p. 7.*

JOHNSON, LYNDON. A NEW BOSS FOR THE SPACE PROGRAM, *by Clarke Newlon, 1/2/61, p. 50.*

KERR, ROBERT S. KEEN MIND FOR SPACE PROBLEMS, *1/16/61, p. 12.*

SHEPARD, CMDR. ALAN B. THREE ASTRONAUTS PICKED, *2/27/61, p. 80.*

SHEPARD, MILLS. MEMO FROM THE PUBLISHER, *3/13/61, p. 6.*

UHL, EDWARD G. UHL CHOSEN TO HEAD FAIRCHILD CORPORATION, *2/13/61, p. 17.*

VAN OSTEN, RICHARD. MEMO FROM THE PUBLISHER, *2/13/61, p. 9.*

WEBB, JAMES E. LET'S NOT HANG AN UNTRIED MAN . . . EDITORIAL *by William J. Coughlin, 3/6/61, p. 50.*

WEBB SURPRISE CHOICE TO HEAD NASA, *2/6/61, p. 17.*

WILKS, BILL. MEMO FROM THE PUBLISHER, *2/20/61, p. 7.*

ZUCKERT, EUGENE C. HOW NEW AF CHIEF PLANS TO PUSH DECISIONS, *1/9/61, p. 12.*

BOOSTERS, SEE SPACE VEHICLES.

BROOKINGS INSTITUTION. REPORT URGES STUDIES OF SPACE IMPACT, *1/2/61, p. 18.*

BUDGET, SEE CONGRESS; UNITED STATES.

BUREAU OF FOREIGN AND DOMESTIC COMMERCE. 'MUST' STOP FOR MISSILE SALESMEN, *3/20/61, p. 38.*

BURTEK, INC. HOW TULSA FIRM MOVES WITH MISSILES, *3/13/61, p. 42.*

C

CABLE, SEE WIRE AND CABLE.

CANADA. CANADA AND NASA; SATELLITE WITH 75-FT. ANTENNAS TO RIDE JAVELIN, *by Bernard Poirier, 4/24/61, p. 18.*

CANADA STEPS UP SPACE EXPLORATION, *by Bernard Poirier, 5/8/61, p. 44.*

CANOGA ELECTRONICS CORP. CANOGA ELECTRONICS STARTS ADVANCED STUDIES PROGRAM, *4/24/61, p. 48.*

CATHAY. NEW ROUTE TO CATHAY—STEP BY STEP; TRANSLATION OF LETTER TO CHRISTOPHER COLUMBUS FROM THE SENATE OF GENOA, *5/29/61, p. 37.*

CERAMIC MATERIALS. BIG SWITCH TO GLASS-PLASTIC CASES, *4/10/61, p. 32.*

BOEING EXPERIMENTS WITH GLASS FIBER

TANKS, 2/6/61, p. 28.
GLASSOCK APPLICATIONS DESCRIBED AS 'LIMITLESS,' by John F. Judge, 4/10/61, p. 26.
SPACE VIEWPORTS: CHALLENGE TO GLASS-MAKERS, by Arthur F. Shoemaker, 1/23/61, p. 40.

CESIUM. CESIUM BEAM IS LEADING TO IMPROVED TIMING ACCURACY, 1/2/61, p. 34.

CHANCE VOUGHT AIRCRAFT, INC. C-V, L-T MERGER WILL FORM A GIANT, 4/10/61, p. 39.
SPACE SIMULATOR CENTER PLANNED, 1/23/61, p. 43.

CHROMATOGRAPH. CHROMATOGRAPH MEASURES CABIN GASES, by Heather M. David, 6/19/61, p. 42.
FCC NEAR CHOICE ON PHONE SATELLITES, by William E. Howard, 6/19/61, p. 14.

CLEANING. CLEANING BARES FLAWS IN MISSILES, by John F. Judge, 3/6/61, p. 32.

COATINGS, HIGH TEMPERATURES FOILED BY FOAM; "SELF SACRIFICING" POLYURETHANE COATING APPLIED BY SPRAYING, 1/9/61, p. 30.
MISSILE HAS SPECIAL PROTECTIVE 'SKIN' by Dr. R. M. Wood and T. J. Ashley, 1/30/61, p. 42.

COLUMBIUM. PLANT TAILORS REFRACTORIES FOR SPACE; NEW DuPONT CENTER TO MAKE VARIED SHAPES OF COLUMBIUM ALLOY; 5/15/61, p. 26.

COMMUNICATION SYSTEMS. ARMY GETS NEW COMMUNICATION SYSTEMS, 6/5/61, p. 30.
'BEANSTALK' ROCKETS FOR SAC SIGNALS, 2/20/61, p. 17.
COMMERCIAL SATELLITE GIVEN GO-AHEAD, by Jay Holmes, 1/9/61, p. 13.
COMMUNICATION SATELLITES . . . BUSINESS IN BILLIONS IS FORECAST, by George J. Feldman, 5/22/61, p. 17.
COMMUNICATIONS TROUBLES WERE FEW; SPECIAL REPORT ON MR-3, 5/15/61, p. 18.
FCC NEAR CHOICE ON PHONE SATELLITES, by William E. Howard, 6/19/61, p. 14.
MARTIN REVEALS ADVANCED VOICE COMMUNICATIONS, 6/12/61, p. 18.
SOCOM TO BETTER SPACE COMMUNICATION, 1/2/61, p. 35.
SPACE COMMUNICATIONS SEEN BY 1965, by William Beller, 5/15/61, p. 24.
SYNDICATE FOR COMMUNICATION SYSTEM? by Jay Holmes, 4/17/61, p. 17.

COMPUTERS. AUTONETICS UNVEILS MINUTEMAN COMPUTER, 1/9/61, p. 29.
COMPUTER KEY TO SPACE ACHIEVEMENT, by R. R. Williamson, 2/27/61, p. 24.
ERECTOR-SET GUIDANCE COMPUTERS, by Hal Gettings, 2/27/61, p. 26.
LOGJAM OF METALS INFORMATION BROKEN; GE COMPUTER PUT TO WORK AT WESTERN RESERVE CAN READ A YEAR'S WRITING IN AN HOUR, 6/19/61, p. 32.

CONGRESS. AT SENATE URGING . . . OVERHAUL COMING IN PROCUREMENT RULES, 2/13/61, p. 16.
DEFENSE NOTES FROM THE CAPITOL, 2/27/61, p. 79.
HUMPHREY HITS OBSOLETE DATA HANDLING; SENATE SUBCOMMITTEE REPORT CITIES LACK OF INTERAGENCY INDEXED INVENTORY-EVEN OF CENTRAL FILE AT NASA, 6/5/61, p. 24.
ON CAPITOL HILL . . . RELATIVELY SMALL BUDGET BOOSTS URGED, 5/8/61, p. 13.
RENEGOTIATION BILL, 2/13/61, p. 16.
ZEUS PRODUCTION GETS NEW BACKING IN CONGRESS, 2/13/61, p. 17.

CONNECTORS. UMBILICAL CONNECTOR EXCEEDS DEMAND OF TITAN II PROGRAM, 6/12/61, p. 32.

CONVENTION ON MILITARY ELECTRONICS. MILITARY ELECTRONICS GET ANNUAL SCRUTINY, 6/19/61, p. 26.

CRYOGENIC ENGINEERING. IBM'S NEW CRYOGENIC MEMORY PLANE, 1/9/61, p. 25.

CURTISS-WRIGHT CORP. C-W AIMS TO RECOUP WITH MISSILE GROWTH, 3/27/61, p. 40.

D

DEAN SPACE DRIVE. CONSULTANT'S REPORT OVERRIDES DEAN SPACE DRIVE, by William Beller, 6/12/61, p. 24.
THE CONTROVERSIAL DEAN SYSTEM SPACE DRIVE, by Charles D. LaFond, 5/1/61, p. 24.
DEAN SPACE DRIVE; LETTERS TO THE EDITOR, 5/29/61, p. 6.

DEPARTMENT OF DEFENSE. DEFENSE PLANS COULD EASILY CHANGE, 4/10/61, p. 15.
DOD LISTS 100 TOP PRIMES FOR 1960, 6/26/61, p. 36.
DOD PLANS MAJOR CHANGE IN INCENTIVE CONTRACTING, by Hal Taylor, 6/26/61, p. 16.
HOW DOD WILL REVISE ITS BUDGETING, by Charles J. Hitch, 5/8/61, p. 17.
SPACE SHAKE-UP COMING; DOD-NASA PROGRAMS BEING REVAMPED, by James Baar, 1/16/61, p. 11.

DIODES. POTENTIAL OF SEMI-METAL DIODES OUTLINED AT APS, 3/13/61, p. 33.

DIVIDING MACHINES. ANCIENT DIVIDER STILL HARD AT WORK IN SPACE AGE, by Charles D. LaFond, 5/15/61, p. 32.

DOUGLAS AIRCRAFT CO. DOUGLAS GEARS UP FOR SATURN S-IV TEST PROGRAM, by Frank G. McGuire, 6/5/61, p. 40.
DOUGLAS REPORT REVEALS DIVERSIFICATION STUDIES, 2/27/61, p. 70.

E

ELECTRICAL PROPULSION. AIR FORCE GETS ITS FIRST ION ENGINE—EOS AIMS FOR BIGGER, BETTER UNITS, 6/19/61, p. 47.
ELECTRICAL PROPULSION PRIORITY URGED, 6/19/61, p. 47.

ELECTRONIC INDUSTRIES ASSOCIATION. EIA MEETING STUDIES 'LIMITED WAR,' 3/13/61, p. 38.

ELECTRONICS INDUSTRY. GOVERNMENT SEES NEW RECORD ELECTRONICS OUTPUT IN 1961, 2/6/61, p. 18.
GUIDANCE MARKET OUTLOOK; SPACE SYSTEMS WILL LIFT G&C MARKET TO $1.5 BILLION, by Charles D. LaFond, 2/27/61, p. 16.
IRE HEARS $30-BILLION MARKET MAY COME BY '70, 3/27/61, p. 38.
ROLE OF ELECTRONICS TO GROW, by Hal Gettings, 3/20/61, p. 13.

ENERGY CONVERSION. MAGNETIC FIELD TO SLOW SPACECRAFT; COOK PROPOSAL WOULD CONVERT HEAT ENERGY INTO ELECTRIC POWER GENERATING RETARDING FORCE, by William Beller, 2/20/61, p. 26.
SPACE POWER FROM MICROWAVE ENERGY? FEASIBILITY OF CONVERSION REPORTED AT NAECON'S BIG ANNUAL MEETING, 5/22/61, p. 33.

ENGINEERS. ENGINEERS' PAY CONTINUES TO CLIMB, by William Beller, 4/3/61, p. 38.
STATUS PROBLEM . . . ENGINEERS HAVE INFERIOR FEELING, by William Beller, 1/9/61, p. 34.

ENVIRONMENTAL TESTING. SYSTEMS MUST BE FLIGHT-TESTED SOON, 3/20/61, p. 32.

EUROPEAN SPACE RESEARCH GROUP. EUROPEANS DEBATE 'SPACE CLUB,' by Anthony Vandyk, 2/6/61, p. 15.
EUROPEANS MAP JOINT SPACE RESEARCH, by Anthony Vandyk, 1/2/61, p. 38.
SPACE CLUB CONSIDERS 90-FT. ROCKET; BRITISH AND FRENCH WOULD BUILD FIRST, SECOND STAGES; THIRD WOULD BE CO-OPERATIVE VENTURE BY 12 NATIONS, by Anthony Vandyk, 2/20/61, p. 36.

F

FAIRCHILD STRATOS CORP. FAIRCHILD'S FUTURE: BIDDING FOR BIG MISSILE/SPACE R&D JOBS, by James Baar, 6/26/61, p. 30.

FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE. F.A.I.'S IMPARTIALITY. LETTER TO THE EDITOR, by Ralph V. Whitener, 1/16/61, p. 48.

FRANCE. FRANCE TO BE MAJOR MISSILE POWER by Bernard Poirier, 2/6/61, p. 40.
FRANCO-BRITISH REPORT SEES SATELLITES UP BY '64, by BERNARD POIRIER, 4/10/61, p. 37.
FRENCH OUTLINE VARIED FIVE-YEAR SPACE PROGRAM, by Jean-Marie Riche, 4/3/61, p. 36.
JOINT U.K.-FRENCH EFFORT PROPOSED BY SIDDELEY, SEREB, by Bernard Poirier, 3/30/61, p. 18.
NATO SPURS FRENCH RANGE EXPANSION, by Bernard Poirier, 3/6/61, p. 42.
TWO FRENCH FIRMS TO MAKE GUIDED BIRDS, by Bernard Poirier, 2/20/61, p. 38.

FUEL CELL. FUEL CELL USES BACTERIA TO PRODUCE POWER, 4/17/61, p. 18.

G

GENERAL DYNAMICS CORP. COMMITTEE WINS G-D $10 MILLION IN CONTRACTS, by William Beller, 5/1/61, p. 36.
IN FY 1960 GENERAL DYNAMICS AND LOCKHEED LED IN AWARDS, 1/30/61, p. 62.

GENERAL ELECTRIC CO. FCC NEAR CHOICE ON PHONE SATELLITES; AT&T GROUP VIES WITH GE AND OTHER MISSILE/SPACE FIRMS, by William E. Howard, 6/19/61, p. 14.

GERMANY. GERMANS SIZING UP BRITAIN'S SEACAT, by Bernard Poirier, 6/5/61, p. 19.

GODDARD MEMORIAL TROPHY. EDITORIAL, by William J. Coughlin, 3/13/61, p. 50.
GODDARD TROPHY GOES TO LOCKHEED MISSILES AND SPACE DIVISION, 3/13/61, p. 19.

GOODRICH, B.F., AVIATION PRODUCTS. GOODRICH EMPHASIZES SUPERIOR SMALL SOLID MOTORS, by Frank G. McGuire, 6/5/61, p. 28.

GOODYEAR AIRCRAFT CORP. GOODYEAR PROPOSES EXPANDABLE STRUCTURES AS SPACE STATIONS, 5/29/61, p. 24.

GOVERNMENT, SEE UNITED STATES.

GREAT BRITAIN. BLUE STEEL PUT INTO FULL PRODUCTION; AVRO'S SYSTEM IS EUROPE'S ONLY INERTIAL MISSILE IN MASS PRODUCTION, by Bernard Poirier, 5/29/61, p. 25.
BRITISH PUSH TACTICAL MISSILE SALES TO NATO NATIONS, by Bernard Poirier, 5/22/61, p. 12.
BRITISH REPORT ON WIDE RANGE OF RESEARCH; UNIVERSITIES, GOVERNMENT AGENCIES ARE COOPERATING IN ROCKET, SATELLITE, TRACKING EXPERIMENTS AND BASIC STUDY, by Anthony Vandyk, 4/24/61, p. 41.
FRANCO-BRITISH REPORT SEES SATELLITES UP BY '64, by Bernard Poirier, 4/10/61, p. 37.
JOINT U.K.-FRENCH EFFORT PROPOSED BY SIDDELEY, SEREB, by Bernard Poirier, 3/20/61, p. 18.
SKYBOLT UNCERTAINTY HAUNTS BRITISH, by James Baar, 5/8/61, p. 10.

VIGILANT SCORES KILL AT —200 YDS., 6/12/61, p. 45.
GROUND SUPPORT EQUIPMENT. AIR SEALS: MISSILEMEN'S KEY TO LIFE, *by William Beller*, 3/20/61, p. 23.
BIG COMPLEX TAKING FORM FOR ATLAS-CENTAUR, 2/20/61, p. 34.
FIRST DETAILS OF PERSHING GSE, *by Hal Gettings*, 5/22/61, p. 24.
HARD FACTS ON GSE ARE STILL TO BE DEVELOPED, *by Hal Gettings*, 5/29/61, p. 76.
LAUNCH PROVES OUT NEW SILO CONCEPT, 5/15/61, p. 42.
MINUTEMAN'S BIG EMPLACEMENT SYSTEM, 4/17/61, p. 40.
NASA GETS HUGE SATURN LAUNCH SITE AT CAPE, 6/12/61, p. 16.
WEST COAST SILO STARTED, 2/13/61, p. 13.
GUIDANCE. ALINEMENT FOR MINUTEMAN-ON-RAILS, *by Richard van Osten*, 2/6/61, p. 33.
THE 'BRAIN' OF THE POLARIS MISSILE, *by R. B. Walter*, 6/12/61, p. 30.
GUIDANCE/ATLAS. ARMA CUTS WEIGHT, ADDS RELIABILITY *by Stan Shatunoff*, 2/27/61, p. 30.
GUIDANCE/CONTROL KNOW-HOW IS AMPLE, *by Charles D. LaFond*, 5/29/61, p. 62.
GUIDANCE/DYNA-SOAR; DYNA-SOAR TO DEPEND ON PROVEN PARTS, *by Paul Yingst and Charles L. Seacord*, 2/27/61, p. 45.
GUIDANCE/MINUTEMAN. MINUTEMAN SYSTEM IS 'MOST RELIABLE,' *by Rolf Winterfelt*, 2/27/61, p. 37.
MARINER CARRIES PLANET FLY-BY HOPES; FIRST DETAILS GUIDANCE PLANNED FOR SHOT PAST VENUS, *by William Beller and Richard van Osten*, 1/2/61, p. 14.
MINUTEMAN EQUIPMENT WELL INTEGRATED, 1/16/61, p. 35.
MINUTEMAN FLIGHT CONTROL AIMS AT LOW MAINTENANCE, 1/2/61, p. 32.
NASA READY TO PICK SATURN GUIDANCE SYSTEM, *by Jay Holmes*, 2/27/61, p. 40.
TITAN II ALL-INERTIAL SYSTEM TO BE TESTED SOON, *by Dr. Joseph Shea*, 2/27/61, p. 33.
TITAN II GUIDANCE TO FLY SOON, 6/19/61, p. 18.
WHICH IS BEST APPROACH TO ACCURATE GUIDANCE OF ICBM'S? COMMAND, *by L. J. France and R. C. Litty*, 2/27/61, p. 28.
WHICH IS BEST APPROACH TO ACCURATE GUIDANCE OF ICBM'S? INERTIAL, *by R. E. Wilson*, 2/27/61, p. 29.
X-15 FLIGHT DATA SYSTEM—A PRECURSOR, *by John F. Judge*, 2/27/61, p. 42.
GYROS. GYROS OF ALL TYPES FACE CHANGE IN DESIGN, *by Bernard Lichtenstein*, 2/27/61, p. 21.

H

HARMONIC DRIVE. NEW DRIVE SHOULD ENHANCE MISSILERY, *by Richard W. Daniels*, 1/16/61, p. 22.
HIGH-TEMPERATURE RESEARCH. HIGH TEMPERATURES FOILED BY FOAM, 1/9/61, p. 30.
HOTTER FURNACE; EOS CHAMBER IS EASILY EXPANDED TO DOUBLE SIZE, 3/20/61, p. 31.
THERMOELECTRIC SULFIDES PRODUCED BY WESTINGHOUSE, 3/13/61, p. 41.
HYDROGEN. HYDROGEN JETS MATCH RE-ENTRY HEAT, *by Joseph N. Steinmetz, Jr.*, 2/20/61, p. 24.

I

INFRARED. IR SPECTROMETER HAS STRIKING SENSITIVITY, *by Charles D. LaFond*, 5/22/61, p. 30.
IR TRANSDUCER BRINGS NEW ADVANTAGES, *by Charles D. LaFond*, 3/20/61, p. 25.
MARINER CARRIES PLANET FLY-BY HOPES; FIRST DETAILS GUIDANCE PLANNED FOR SHOT PAST VENUS; INFRARED SCANNER IS KEY FOR LOCATING PLANET FROM FIGURE 100,000 MILES OUT, *by William Beller and Richard van Osten*, 1/2/61, p. 14.
INSTITUTE OF RADIO ENGINEERS. IRE CONVENTION TOLD . . . RADIATION EFFECTS ARE LITTLE KNOWN, *by Richard van Osten*, 2/13/61, p. 42.
INSULATION. MISSILE HAS SPECIAL PROTECTIVE 'SKIN' *by Dr. R. M. Wood and T. J. Ashley*, 1/30/61, p. 42.
INTERNATIONAL BUSINESS MACHINES CORP. IBM Dedicates Giant Research Center, 5/8/61, p. 24.
IBM'S CRYOGENIC MEMORY PLANES, 1/9/61, p. 25.
ION PROPULSION. AIR FORCE GETS ITS FIRST ION ENGINE—EOS AIMS FOR BIGGER, BETTER UNITS, 6/19/61, p. 24.

L

LABOR. GOLDBERG READY TO MOVE AGAINST WORK STOPPAGES, 5/15/61, p. 12.
LESSONS FROM THE LABOR HEARINGS; EDITORIAL *by William J. Coughlin*, 5/22/61, p. 54.
LAMINAR COMBUSTION. SUPERSONIC BURNING PROBED; MAY BRING NEW MISSILE TYPE, 1/9/61, p. 33.
LAND-AIR, INC. LAND-AIR'S WHITE SANDS TRACKING, 2/16/61, p. 28.
LASER. 'EXOTIC' COMMUNICATIONS OF SMALL USE; MARTIN ENGINEER FINDS THAT LASER AND DEFLECTED SUNLIGHT ARE ONLY APPROACHES IN EXOTIC REGION WHICH APPEAR TO HAVE PRACTICAL VALUE, 6/12/61, p. 37.
GASEOUS LASER HOLDS VAST PROMISE, 2/16/61, p. 38.
LASER, FIBER OPTICS TECHNOLOGIES JOIN, *by Charles D. LaFond*, 5/8/61, p. 33.
LASERS FOR INTERGALAXIAL CONTACT? *by Charles D. LaFond*, 3/13/61, p. 32.
LING-TEMCO ELECTRONICS. C-V, L-T MERGER WILL FORM A GIANT, 4/10/61, p. 39.
LIQUIDOMETER. LIQUIDOMETER MEASURES WEIGHTLESS LIQUIDS, 1/23/61, p. 32.
LOCKHEED AIRCRAFT CORP. IN FY 1960 GENERAL DYNAMICS AND LOCKHEED LED IN AWARDS, 1/30/61, p. 62.
LOCKHEED BUILDING REACTOR FOR NASA, 2/6/61, p. 38.
LOCKHEED EYES SPACE BUSINESS POSSIBILITIES, 2/20/61, p. 18.

M

MAGNETOGASDYNAMICS. MAGNETOGASDYNAMICS GAINS REPORTED BY NORAIR DIV., *by Frank G. McGuire*, 5/15/61, p. 30.
MAGNETOHYDRODYNAMCS. MHD POWER EXPERIMENTS TOP RESULTS EXPECTED, *by Hal Gettings*, 4/17/61, p. 23.
MAGNETOMETER. MAJOR NEW RADIATION PROBE READIED, *by Charles D. LaFond and Jay Holmes*, 1/16/61, p. 14.
MAN IN SPACE. HIGHLIGHTS OF SHEPARD'S SMOOTH TRIP, 5/15/61, p. 14.
MR-3 PROVES MAN IS MOST RELIABLE SPACE MACHINE; *Special Report by Jay Holmes*, 5/15/61, p. 13.
MR-3'S IMPORT DISTORTED BY PUBLICITY, *by Jay Holmes*, 5/8/61, p. 11.
MAN IN SPACE, *by James Baar*, 5/29/61, p. 33.
SCIENCE TAKES DIM VIEW OF MAN IN SPACE, 5/29/61, p. 36.
SEE ALSO SPACECRAFT.
MAPPING. ARMY WILL SPEED MAPPING, 3/27/61, p. 33.
NEW SATELLITE CONFIGURATION STUDIED FOR SECOR; WOULD OFFER ADVANTAGES FOR ARMY'S PRECISION MAPPING PROGRAM, 2/6/61, p. 22.
U.S. CHARTS SURFACE OF MOON, *Charles D. LaFond*, 4/3/61, p. 34.
MARS. MARINER CARRIES PLANET FLY-BY HOPES, *by William Beller and Richard van Osten*, 1/2/61, p. 14.
MARTIN CO. MARTIN CO. NOW STRICTLY MISSILE/SPACE BUSINESS, 1/2/61, p. 32.
MARTIN DRIVES FOR TOP ROLE IN ELECTRONICS, *by Charles D. LaFond*, 6/19/61, p. 40.
MARTIN SHOWS ITS 'AUDIO-AUTOMATION,' 3/13/61, p. 38.
MARTIN'S ANSWER: RIAS SEEKS KNOWLEDGE FOR ITS OWN SAKE, 1/16/61, p. 20.
MASS SPECTROMETER. RAYTHEON DEVELOPS DEVICE TO STUDY GAS COMPOSITION, 1/2/61, p. 34.
MEASUREMENT. GWU OFFERS FIRST CLASS IN MEASUREMENT SCIENCE, 2/6/61, p. 28.
PRICE OF INADEQUATE MEASUREMENT STANDARDS, 2/6/61, p. 26.
METAL WORKING. HONEYCOMB STRUCTURE OUTPUT SPEEDED; VACUUM BRAZING PROCESS USED BY GRUMMAN, 5/1/61, p. 42.
CURTISS-WRIGHT DEEP IN MOTOR CASE TECHNOLOGY; EXPERIENCE IN METALLURGY SPAWNS FRESH APPROACHES TO PROBLEM OF CONTAINMENT OF ENERGETIC SOLID FUELS, *by John F. Judge*, 6/26/61, p. 24.
FASTER NUMERICAL CONTROL PROGRAMING; 'AUTOPROMT' LANGUAGE SYSTEM DEVELOPED BY IBM WITH HELP FROM UNITED AIRCRAFT IS SLASHING MILL TIME AS WELL, 6/26/61, p. 32.
HUGE PRESS TO MAKE RECORD FORGINGS, 1/9/61, p. 32.
SOVIETS REPORTED WORKING ON HYBRID METAL PROCESS, 3/20/61, p. 34.
STRENGTH OF CASTINGS MULTIPLIED BY FORGING, *by John F. Judge*, 3/20/61, p. 30.
METEORITES. METEORITES NO HAZARD; LETTER TO THE EDITOR, *by Richard B. Hoag*, 3/6/61, p. 48.
METEOROIDS. DUST IN NEAR SPACE MAY ANNOY AN ASTRONAUT, 2/20/61, p. 30.
EXPLORER FINDS NEW WAY TO ORIENT
NASA REPORTS THAT 95% SUCCESSFUL MISSION BY EXPLORER VIII HAS ALSO YIELDED BEST DATA YET ON MICROMETEOROID RISK, *by Hal Gettings*, 6/19/61, p. 16.
S-55 TO EXPLORE THREAT OF PUNCTURE FROM 'SPACE DUST' *by Hal Gettings*, 6/12/61, p. 14.
METEOROLOGICAL SATELLITE SYSTEM. WEATHER-SATELLITE BIRTH PAINS, *by Jay Holmes*, 3/13/61, p. 17.
MISSILE BASES. MACE B BASES READIED ON OKINAWA, *by Frank G. McGuire*, 3/13/61, p. 18.
NIKE-ZEUS BASES WOULD BE MANY AND SPRAWLING, 1/30/61, p. 49.
MISSILE-FIRING SUBMARINES. FIRST POLARIS SUB RETURNS, 1/30/61, p. 62.
FOURTH POLARIS SUBMARINE JOINS ATLANTIC FLEET, 3/6/61, p. 16.
MISSILE LAUNCHING. SEA LAUNCHING; FLEXIBILITY BEHIND IDEA FOR DRYDOCK PLATFORMS, *by William Beller*, 4/24/61, p. 28.
SLAG MAKES POLARIS FIRINGS FAIL-SAFE, *by Ben Strunk*, 1/9/61, p. 23.
MISSILE TRACKING. AGAVE TRACKING SYSTEM GOES TO SEA, 2/13/61, p. 28.
LAND-AIR'S WHITE SANDS TRACKING, 1/16/61, p. 28.

MISSILES AND ROCKETS. MISSILES AND ROCKETS ASTROLOG; CURRENT STATUS OF U.S. MISSILE AND SPACE PROGRAMS PLUS ALL ORBITING SATELLITES, 1/2/61, p. 23; 3/6/61, p. 22; 5/8/61, p. 25.
AS-30. FRENCH, BRITISH BID FOR NATO SALES; FIRST SHOWINGS OF FRENCH AS-30, U.K.'S RED TOP, 6/5/61, p. 15.
AS-30. RELATIVE MERITS OF AS-30 AND BULLPUP SHARPLY DEBATED, 6/5/61, p. 18.
BLUE STEEL. BLUE STEEL PUT INTO FULL PRODUCTION; AVRO'S SYSTEM IS EUROPE'S ONLY INERTIAL MISSILE IN MASS PRODUCTION, by Bernard Poirier, 5/29/61, p. 25.
BLUE WATER. BLUE WATER UNVEILING . . . BRITISH PUSH TACTICAL MISSILE SALES TO NATO NATIONS, by Bernard Poirier, 5/22/61, p. 12.
BOMARC. U.S. BEEFS UP BOMARC PROTECTION, 5/1/61, p. 18.
BULLPUP. RELATIVE MERITS OF AS-30 AND BULLPUP SHARPLY DEBATED, 6/5/61, p. 18.
DAVY CROCKETT. DAVY CROCKETT TAKES A BOW, 1/9/61, p. 7.
ENTAC. ARMY READY TO BUY ENTAC; FIRST LARGE-SCALE PURCHASE ABROAD BY U.S., by William E. Howard, 3/27/61, p. 14.
LAWMAN. G.I. TO GET EASY HANDLING TANK KILLER, 1/16/61, p. 34.
MALKARA. AUSTRALIA'S MALKARA DEATH TO BUNKERS, by Alan S. Hulme, 4/10/61, p. 38.
MINUTEMAN. ALINEMENT FOR MINUTEMAN-ON-RAILS, by Richard van Osten, 2/6/61, p. 33.
MINUTEMAN. MINUTEMAN EQUIPMENT WELL INTEGRATED, 1/16/61, p. 35.
MINUTEMAN. MINUTEMAN FLIGHT CONTROL AIMS AT LOW MAINTENANCE, 1/2/61, p. 32.
MINUTEMAN. MINUTEMAN GUIDANCE SYSTEM IS 'MOST RELIABLE,' by Rolf Winterfelt, 2/27/61. p. 37.
MINUTEMAN. MINUTEMAN PASSES FIRST FLIGHT TEST, 2/6/61, p. 14.
NIKE-ZEUS SEE ANTIMISSILE MISSILES.
PERSHING. FIRST DETAILS OF PERSHNG GSE, by Hal Gettings, 5/22/61, p. 24.
PERSHNG. TRUDEAU LASHES BACK AT PERSHING CRITICS, 6/12/61, p. 12.
POLARIS. THE 'BRAIN' OF THE POLARIS MISSILE, by R. B. Walter, 6/12/61, p. 30.
RED TOP. FRENCH, BRITISH BID FOR NATO SALES; FIRST SHOWINGS OF FRENCH AS-30, U.K.'S RED TOP, 6/5/61, p. 15.
REDSTONE. REDSTONE'S YEARS OF FRUSTRATION, by James Baar, 5/15/61, p. 17.
SS-11. ARMY READY TO BUY ENTAC; FIRST LARGE-SCALE PURCHASE ABROAD BY U.S., ARMY ALSO SAID TO BE ACQUIRING FRENCH SS-11'S by William E. Howard, 3/27/61, p. 14.
SEACAT. GERMANS SIZING UP BRITAIN'S SEACAT, by Bernard Poirier, 6/5/61, p. 19.
SEASLUG. SEASLUG SUCCESS WINS OKAY FOR MARK 2, by Bernard Poirier, 6/26/61, p. 34.
SKYBOLT. SKYBOLT UNCERTAINTY HAUNTS BRITISH, by James Baar, 5/8/61, p. 10.
SPARROW III. NEW SPARROWS TO HAVE SOLID MOTORS AFTER ALL, 6/5/61, p. 27.
TARTAR. NEW TARTAR MOTOR NOW IN PRODUCTION, 6/5/61, p. 26.
TARTAR. TARTAR'S DIRECTOR IS OUTSTANDING IN FIELD, by Hal Gettings, 4/10/61, p. 22.
TITAN. TITAN GETS ABLATIVE SKIRT ON 2ND STAGE, by Frank G. McGuire, 5/8/61, p. 22.
TITAN. TITAN SUPERBOOSTER BY 1963, by James Baar, 6/12/61, p. 12.
TITAN. TITAN'S 5000-MILE SUCCESS GIVES SYSTEM PUSH FORWARD, 2/20/61, p. 27.
TITAN II. TITAN II ALL-INERTIAL SYSTEM TO BE TESTED SOON, by Dr. Joseph Shea, 2/27/61, p. 33.
VIGILANT. VIGILANT SCORES KILL AT—200 YDS., 6/12/61, p. 45.
MOON. ARMOUR STUDY INDICATES MARIA MAY BE BEST BET FOR LUNAR LANDINGS, by William Beller 6/19/61, p. 34.
HAVE WE ONE GOOD REASON TO COLONIZE OUTER SPACE?, by Dandridge M. Cole, 5/29/61, p. 86.
MOON DUST MAY BE THIN ENOUGH FOR SOFT LANDINGS, 1/2/61, p. 39.
MOON'S POTENTIAL; LETTER TO THE EDITOR by Edward H. Dingman, 6/5/61, p. 6.
NEW FORMULA FOR PRICING SPACE WORK; AAS MEETING TOLD OF CHANCE VOUGHT COST ANALYSIS METHOD; 8-YEAR MOON ROUND TRIP PLAN TAGGED AT $3.1 BILLION, 2/6/61, p. 38.
ORBITAL WORK CAN AID MOON LANDING, 5/29/61, p. 24.
RUSSIAN MAP SHOWS MOON'S FAR SIDE MAY BE BEST FOR LANDING, by William Beller, 5/22/61, p. 40.
U.S. CHARTS SURFACE OF MOON, by Charles D. LaFond, 4/3/61, p. 34.

N

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD CENTER HALF COMPLETED, 3/20/61, p. 14.
HOW MUCH MORE SHOULD NASA ASK? 2/6/61, p. 42.
MARSHALL'S $70-MILLION BUILDING BOOM, 1/16/61, p. 25.
NASA BEGINS PUSH FOR THE BIG SOLID-FUEL BOOSTERS, by Jay Holmes, 3/20/61, p. 16.
NASA FINDS SOLAR PROBE IS FEASIBLE, by John F. Judge, 5/8/61, p. 35.
NASA GETS HUGE SATURN LAUNCH SITE AT CAPE, 6/12/61, p. 16.
NASA INCREASE WILL HURRY BIG BOOSTERS, 4/3/61, p. 14.
NASA MAY ASK FOR EXTRA $200 MILLION, 2/27/61, p. 83.
NASA MAY NEED MONTHS TO PLAN ADDED APOLLO SPENDING, 6/5/61, p. 13.
NASA PUTS NEW REACTOR TO WORK, 4/3/61, p. 24.
NASA STRETCHES OUT SPACE PROGRAM, 1/9/61, p. 15.
NASA SUBMITS OVERHAULED INDEMNIFICATION LEGISLATION, 6/12/61, p. 44.
NASA TACKLES RECRUITMENT OF 6000 ENGINEERS AND TECHNICIANS FOR SPACEFLIGHT PROGRAM, by Hal Gettings, 6/26/61, p. 15.
NASA'S COMMUNICATION SATELLITE R&D SCHEDULE, 4/17/61, p. 17.
1961 LAUNCHES; NASA SCHEDULE LISTS 36 MAJOR SPACE SHOTS, 1/9/61, p. 14.
SPACE SHAKE-UP COMING; DOD-NASA PROGRAMS BEING REVAMPED, by James Baar, 1/16/61, p. 11.
NATIONAL AEROSPACE ELECTRONICS CONFERENCE. SPACE POWER FROM MICROWAVE ENERGY? FEASIBILITY OF CONVERSION REPORTED AT NAECON'S BIG ANNUAL MEETING, 5/22/61, p. 33.
NATIONAL BUREAU OF STANDARDS. NBS PLANS BASIC PROPAGATION STUDIES, by Hal Gettings, 4/24/61, p. 25.
SUPERSONIC BURNING PROBED; MAY BRING NEW TYPE MISSILE; NBS LABORATORY OBSERVES NEW PHENOMENA-LAMINAR COMBUSTION, 1/9/61, p. 33.
NATIONAL CONFERENCE ON PEACEFUL USES OF SPACE. PEACEFUL BENEFITS OF SPACE LAUDED AT TULSA CONFERENCE, by John W. Herrick, 6/5/61, p. 45.
NATIONAL TELEMETRY CONFERENCE. TELEMETRY CAN BE OVER-STANDARDIZED; NTC COMMITTEE REPORTS, 5/29/61, p. 26.
NAVY. LANGLEY HYDRODYNAMIC RESEARCH SWITCHED TO NAVY, 1/16/61, p. 32.
MC NAMARA REPORTED FAVORING ARMY-NAVY STRATEGY OF 'FINITE DETERRENCE' by James Baar, 3/6/61, p. 14.
SEE ALSO, ANTISUBMARINE WARFARE; MISSILE-FIRING SUBMARINES.
NONDESTRUCTIVE TESTING. IGNORANT TEST TECHNIQUES DEPLORED, 6/12/61, p. 40.
NORTH AMERICAN AVIATION, INC. ACTUAL X-15 ALTITUDE: 32 MILES PLUS, 4/10/61, p. 19.
NORTH AMERCIAN AEROSPACE LABORATORY, 3/13/61, p. 43.
X-15 PROGRESS REPORT, 2/20/61, p. 6.
NORTH ATLANTIC TREATY ORGANIZATION. BRITISH PUSH TACTICAL MISSILE SALES TO NATO NATIONS, 5/22/61, p. 12.
FRENCH, BRITISH BID FOR NATO SALES, 6/5/61, p. 15.
NATO SPURS FRENCH RANGE EXPANSION, by Bernard Poirier, 3/6/61, p. 42.
NORTHROP CORP. NORAIR SLATED TO GET MACH 14 WIND TUNNEL, 2/20/61, p. 27.
NUCLEAR PROPULSION. HIGHEST PRIORITY URGED FOR THE ROVER NUCLEAR ROCKET, 5/29/61, p. 27.
LOCKHEED BUILDING REACTOR FOR NASA, 2/6/61, p. 38.
NUCLEAR SPACE TRANSPORTATION SEEN FEASIBLE WITHIN DECADE, 3/20/61, p. 24.
ON NUCLEAR POWER AND SAFETY, by Clarke Newlon, 1/16/61, p. 50.
TORY IIA-1 RUN AIDS PLUTO OUTLOOK, by Frank G. McGuire, 5/22/61, p. 15.
TORY IIA [REACTOR] GETS TESTS AIMED AT FULL-POWER OPERATION, 1/16/61, p. 40.
U.S. URGED TO EXPLOIT NUCLEAR LEAD, by John F. Judge, 5/22/61, p. 27.

O

OCEANOGRAPHY. KENNEDY SEEKS RECORD SPENDING FOR OCEANOGRAPHY, by William Beller, 4/10/61, p. 24.
OFFICE OF CIVIL AND DEFENSE MOBILIZATION. CD CONTROVERSY . . . HOEGH DISPUTES MILITARY TAKEOVER, 1/9/61, p. 40.
OLIN MATHIESON CHEMICAL CO. WORLD'S BIGGEST . . . OLIN'S ANHYDROUS HYDRAZINE PLANT PRODUCING, 5/22/61, p. 18.
OPTICAL SOCIETY OF AMERICA. LASERS FOR INTERGALAXIAL CONTACT? HIGHLIGHTS OF OSA SPRING MEETING, by Charles D. LaFond, 3/13/61, p. 32.
OPTICS. HUGHES DEVELOPS OPTICAL SPACE RADAR, 3/6/61, p. 18.
LASER, FIBER OPTICS TECHNOLOGIES JOIN, by Charles D. LaFond, 5/8/61, p. 33.
TRAP KEEPS LIGHT OFF CRT SURFACES; DOUGLAS DEVICE, USING FINE CELLS TO ABSORB RAYS, GIVES UNIQUE READABILITY, 6/19/61, p. 36.

P

PARAGLIDER RECOVERY SYSTEM. SATURN MAY 'FLY' BACK TO LAUNCH SITE, 5/15/61, p. 40.
PARIS AIR SHOW. FRENCH, BRITISH BID FOR NATO SALES; SPECIAL REPORT ON THE PARIS AIR SHOW, 6/5/61, p. 15.
HARSH DECISION AT PARIS, editorial by William J. Coughlin, 6/5/61, p. 52.
PROCUREMENT. FEDERAL PROPERTY RULES NEED CHANGING, by John D. Truesdale, 4/10/61, p. 41.
GOVERNMENT CONTRACTING NEEDS OVERHAUL, 3/13/61, p. 19.

OVERHAUL COMING IN PROCUREMENT RULES, 2/13/61, p. 16.

PROPULSION ENGINEERING. CONSUMABLE CASE ROCKET DESCRIBED, *by Frank G. McGuire*, 2/13/61, p. 35.

DIRECT WINDING MAY CUT CASE COST, *by Frank G. McGuire*, 4/24/61, p. 30.

GOODRICH EMPHASIZES SUPERIOR SMALL SOLID MOTORS, *by Frank G. McGuire*, 6/5/61, p. 28.

JOSHUA PRODUCES PROGRESS IN HIGH-ENERGY STORABLE FUEL, 5/22/61, p. 44.

MARQUARDT DESCRIBES LACE, NULACE; DEVELOPER CLAIMS HIGH EFFICIENCIES FOR ENGINES AIMED AT USE IN AEROSPACE PLANE-HYBRIDIZATION ENHANCES OVERALL PERFORMANCE, 5/22/61, p. 14.

PROPELLANT LOADING SYSTEM CUTS DOWN FUEL BURDEN, *by John F. Judge*, 6/12/61, p. 34.

SUPERSONIC BURNING PROBED; MAY BRING NEW TYPE MISSILE, 1/9/61, p. 33.

SOLID SAVINGS; SWITCHOVER IN BOOSTER FUEL URGED BY GECKLER, 2/6/61, p. 32.

TOWARD SAFETY IN HANDLING OF PROPELLANTS, *by H. A. Volz*, 2/13/61, p. 34.

SEE ALSO SPACE VEHICLES.

R

RADAR. AJAX RADAR SIMULATORS TO BE CHANGED FOR HERCULES, 4/17/61, p. 44.

HUGHES DEVELOPS OPTICAL SPACE RADAR, 3/6/61, p. 18.

NEW AUTOMATIC RADAR SIGHTING SYSTEM UNVEILED, *by Anthony Vandyk*, 1/9/61, p. 37.

NIKE-ZEUS; TOUGH RADAR PROBLEMS ALREADY SOLVED, *by Charles D. LaFond and Hal Gettings*, 1/30/61, p. 31.

SERVONICS' TWS, HIGHLY VERSATILE SYSTEM, *by Charles D. LaFond*, 1/23/61, p. 29.

RADIATION. NASA'S S-3 SATELLITE TO INVESTIGATE RADIATION, 2/13/61, p. 40.

NERV DATA ALTERS THINKING ON SHIELDING, *by Jay Holmes*, 2/20/61, p. 28.

PROTONS THREATEN SOLAR CELLS AND TRANSISTORS, 5/1/61, p. 47.

RADIATION HAZARD IS TOP FLIGHT PROBLEM, *by John F. Judge*, 5/29/61, p. 49.

SOLAR FLARES POSE WEIGHT PROBLEM, 1/9/61, p. 18.

RADIO CORPORATION OF AMERICA. RCA BUILDING ADVANCED VEHICLE TESTING CENTER, 3/13/61, p. 24.

RADIOMETER. RADIOMETER TO IMPROVE FORECASTING, 1/23/61, p. 35.

RE-ENTRY. HYDROGEN JETS MATCH RE-ENTRY HEAT, *by Joseph N. Steinmetz, Jr.*, 2/20/61, p. 24.

MAGNETIC FIELD TO SLOW SPACECRAFT, *by William Beller*, 2/20/61, p. 26.

SAPPHIRE WHISKERS FOR SAFER RE-ENTRY, 4/3/61, p. 36.

REFRIGERATION. 'ICE BOX' BEST FOR SHORT SPACE TRIPS, 6/12/61, p. 36.

RELIABILITY. EXHAUSTIVE TESTS BRING RELIABILITY, 5/22/61, p. 29.

REPUBLIC AVIATION CORP. REPUBLIC PLANT HAS 7 SPECIALIZED LABS, 5/8/61, p. 40.

S

SAFETY. GERSIS TO INSURE SAFETY IN NIKE-ZEUS PMR FIRING, 3/20/61, p. 34.

MISSILE SAFETY COURSES; LETTER TO THE EDITOR, *by Eugene Mimitruk*, 5/8/61, p. 6.

TOWARD SAFETY OF HANDLING OF PROPELLANTS, *by H. A. Volz*, 2/13/61, p. 34.

SALVAGE. NRL PROCESS CUTS FIRE, FLOOD DAMAGE; CLEANING TECHNIQUE HAS ALREADY SAVED MILLIONS OF DOLLARS IN REFITTING BURNED CARRIER AND IS CHANGING MILITARY'S 'SCRAP IT' POLICY, *by William Beller*, 6/26/61, p. 28.

SATELLITES. MISSILES AND ROCKETS ASTROLOG; CURRENT STATUS OF U.S. MISSILE AND SPACE PROGRAMS PLUS ALL ORBITING SATELLITES, 1/2/61, p. 23; 3/6/61, p. 22; 5/8/61, p. 25.

COMMERCIAL SATELLITE GIVEN GO-AHEAD, *by Jay Holmes*, 1/9/61, p. 13.

ADVENT. WEIGHT ADDED TO ARMY'S ADVENT, 6/12/61, p. 13.

DISCOVERER. DISCOVERER ADVANCES ON FIVE FRONTS, 2/27/61, p. 82.

DISCOVERER XXII. DISCOVERER XXII ORBIT FAILURE STUDIED, 4/10/61, p. 35.

ECHO I. SOLAR STORM CHANGES ORBIT OF NASA'S ECHO I SATELLITE, 1/9/61, p. 45.

EXPLORER VIII. EXPLORER FINDS NEW WAY TO ORIENT, *by Hal Gettings*, 6/19/61, p. 16.

EXPLORER IX. EXPLORER IX—FIRST SATELLITE ORBITED BY ALL-SOLID VEHICLE, 2/27/61, p. 84.

EXPLORER X. EXPLORER X FINDINGS, 4/3/61, p. 11.

LOFTI. LOFTI DATA CHANGES THOUGHTS ON VLF, 4/10/61, p. 35.

LONGLEGS. CANADA AND NASA; SATELLITE WITH 75-FT. ANTENNAS TO RIDE JAVELIN, *by Bernard Poirier*, 6/26/61, p. 18.

NIMBUS. G.E. WINS DELAYED CONTEST FOR PRIME NIMBUS CONTRACT, 2/13/61, p. 18.

OAO NO. 3. FIRST DETAILS OF OAO NO. 3 EXPERIMENT; PRINCETON-DIRECTED PROJECT WILL COLLECT DATA BY ROCKET TO HELP DETERMINE SATELLITE PAYLOAD, *by Charles D. LaFond*, 6/26/61, p. 26.

S-3. NASA'S S-3 SATELLITE TO INVESTIGATE RADIATION, 2/13/61, p. 40.

S-15. S-15 SATELLITE MAY SOLVE COSMIC RAY RIDDLE, *by William Beller*, 2/6/61, p. 24.

S-15. S-15 TO HUNT FOR GAMMA RADIATION, 4/3/61, p. 19.

S-16. FIRST 'STREETCAR' DUE TO GO SOON, 3/27/61, p. 34.

S-45. S-45 BEACON SATELLITE TO BE TRACKED BY NEW ZEALAND, 2/13/61, p. 41.

S-45. S-45 WILL BE STUDIED AROUND THE GLOBE, *by Jay Holmes*, 4/3/61, p. 16.

S-48 TO SOUND HIGH IONOSPHERE; FIXED-FREQUENCY SATELLITE WILL MEASURE DENSITY OF ELECTRONS; CANADA'S S-27 TO USE SWEPT FREQUENCY, 6/26/61, p. 12.

S-55. S-55 TO EXPLORE THREAT OF PUNCTURES FROM 'SPACE DUST,' *by Hal Gettings*, 6/12/61, p. 14.

SAMOS II BIG TRIUMPH FOR U.S., 2/6/61, p. 15.

TIROS. LONG-LIVED TIROS DOUBLES ORIGINAL LIFE EXPECTANCY, 6/5/61, p. 37.

TIROS II. TIROS II REDUCED TO IR, DIRECT OBSERVATION, 1/30/61, p. 64.

SILVER QUILL AWARD. ADM. BURKE TO RECEIVE 1960 SILVER QUILL AWARD, 1/23/61, p. 16.

'SIZING' LAW. THE 'SIZING' LAW, 6/19/61, p. 30.

SOCIETY OF AEROSPACE MATERIALS AND PROCESS ENGINEERS. BIG SWITCH TO GLASS-PLASTIC CASES; TREND IS HIGHLIGHT OF SAMPE MEETING, *by Frank G. McGuire*, 4/10/61, p. 32.

SOLAR FLARES. SFR KNOWLEDGE CAN CUT SHIELDING, 4/17/61, p. 31.

SOLAR FLARES POSE WEIGHT PROBLEM, 1/9/61, p. 18.

SOLAR OPTICAL COMMUNICATIONS SYSTEM. SOCOM TO BETTER SPACE COMMUNICATION, 1/2/61, p. 35.

SOLAR POWER. STEPS SOLAR-POWER SYSTEM TO BE TESTED SOON, *by William Beller*, 6/5/61, p. 22.

SOLAR WIND. SOLAR WIND EXISTENCE IS PROVEN BY EXPLORER X, *by Jay Holmes*, 4/24/61, p. 17.

SOUNDING ROCKETS. SPACE DUST BROUGHT BACK BY ROCKETS, 6/19/61, p. 40.

WEATHER ROCKETS FIRED ONE-AN-HOUR, 5/22/61, p. 16.

SPACE MEDICINE. CHIMPS WILL BE ORBITED FOR WEEKS, 5/1/61, p. 17.

ENDLESS RECYCLING OF WATER & OXYGEN, *by Heather M. David*, 3/13/61, p. 22.

EXPERTS FEAR VENUS CONTAMINATION, *by Heather M. David*, 2/20/61, p. 30.

EXPERTS WARN OF LIFE SUPPORT GAP, *by Heather M. David*, 5/15/61, p. 46.

HOW TO MAKE MAN EFFICIENT IN SPACE? *by Heather M. David*, 1/2/61, p. 19.

LIFE SCIENTISTS DEMAND TOP PRIORITY, *by Heather M. David*, 5/29/61, p. 44.

MICE IMPACTED TO SAVE ASTRONAUTS, *by Heather M. David*, 4/17/61, p. 35.

MICROORGANISMS SURVIVE VACUUM, 6/19/61, p. 46.

RAT FLIGHT PROVIDES DATA ENCOURAGING FOR MAN, 5/22/61, p. 42.

SPACE BLOOD PRESSURE; LETTER TO THE EDITOR, *by L. A. Geddes*, 2/13/61, p. 47.

SPUTNIK V SHOWS SOVIETS' KNOW-HOW; RESULTS SHOW RUSSIANS CAN NOW BUILD SPACE ENVIRONMENT ACCEPTABLE TO HUMAN BEINGS, 1/23/61, p. 22.

WEIGHTLESSNESS LOWERS PERFORMANCE, *by Heather M. David*, 5/22/61, p. 36.

SPACE SUITS. AF ORDERS 'QUICK CHANGE' SPACE SUIT, *by Heather M. David*, 4/24/61, p. 18.

SPACE TECHNOLOGY LABORATORIES. DATA SHOWS STL'S ATLAS-ABLE ENGINE FUNCTIONED, *by John W. Herrick*, 5/1/61, p. 44.

STL TO BUILD NEW ENGINE TEST PLANT, INCREASE STAFF, 5/1/61, p. 47.

SPACE VEHICLE RECOVERY. SATURN MAY 'FLY' BACK TO LAUNCH SITE, 5/15/61, p. 40.

SPACE VEHICLES. ASTROLOG; CURRENT STATUS OF U.S. MISSILE AND SPACE PROGRAMS, 1/2/61, p. 23; 3/6/61, p. 22; 5/8/61, p. 25.

BIG SOLIDS—BOOSTER BREAKTHROUGH? *by Jay Holmes*, 3/6/61, p. 13.

BOOSTER IDEAS ARE BIG AND VARIED, *by Frank G. McGuire*, 5/29/61, p. 39.

BOOSTER INITIATIVE; LETTER TO THE EDITOR, *by C. P. Wilson*, 4/10/61, p. 48.

BOOSTER PROGRAM MAY BE SPEEDED, 2/20/61, p. 16.

NASA BEGINS PUSH FOR BIG SOLID-FUEL BOOSTERS, *by Jay Holmes*, 3/20/61, p. 16.

NASA GIVES GO-AHEAD TO SEGMENTED UTC MOTOR, 4/24/61, p. 21.

NASA INCREASE WILL HURRY BIG BOOSTERS, 4/3/61, p. 14.

NO EASY CURE FOR THE BOOSTER GAP, 5/1/61, p. 14.

THREE FIRMS TO STUDY POST-SATURN VEHICLES, 3/20/61, p. 28.

AF SOLID BOOSTER TO COST MORE THAN $2 BILLION, 6/26/61, p. 14.

ATLAS. ATLAS-BASED SHOT FAILURES WORRY NASA PLANNERS, 1/2/61, p. 17.

ATLAS. STICKING WITH ATLAS . . . MERCURY MEN BALK AT SWITCH TO TITAN, 1/16/61, p. 13.

ATLAS-G. ATLAS-G BOOSTERS AWAIT GO-

AHEAD, *by Richard van Osten, 3/13/61, p. 16.*

ATLAS-ABLE. DATA SHOWS STL'S ATLAS-ABLE ENGINE FUNCTIONED, *by John W. Herrick, 5/1/61, p. 44.*

BLUE SCOUT. MORE BLUE SCOUT SHOTS SCHEDULED SOON, *1/16/61, p. 16.*

BLUE SCOUT II. SCOUT ADVANCES; SUCCESSFUL FLIGHT WITH FOURTH-STAGE GUIDANCE, *3/13/61, p. 41.*

CENTAUR. FIRST CENTAUR FLIGHTS TO PRECEDE TRACKING NET, *1/23/61, p. 37.*

CENTAUR. U.S. PRESSES EFFORT ON CENTAUR, *4/10/61, p. 17.*

SATURN. MARSHALL CENTER SEEKS WINGS FOR SATURN LANDING, *2/6/61, p. 32.*

SATURN. OVERTIME WON'T HELP SPEED SATURN, *5/8/61, p. 14.*

SATURN C-1. ENGINES ADDED TO SATURN C-1, *by Jay Holmes, 4/10/61, p. 16.*

SATURN S-II. RECORD SATURN II CONTRACT AWARD EXPECTED IN AUTUMN, *4/24/61, p. 31.*

SATURN S-II. SATURN GIVEN 6-9 MONTH SPEED-UP, *6/19/61, p. 15.*

SATURN S-IV. DOUGLAS GEARS UP FOR SATURN. S-IV TEST PROGRAM, *by Frank G. McGuire, 6/5/61, p. 40.*

SPACECRAFT. DESIGNING DATA DISPLAY FOR PILOT OF SPACECRAFT, *by Charles Owen Hopkins and D. K. Bauerschmidt, 4/3/61, p. 28.*

MISSILES AND ROCKETS ASTROLOG; CURRENT STATUS OF U.S. MISSILE AND SPACE PROGRAMS PLUS ALL ORBITING SATELLITES, *1/2/61, p. 23; 3/6/61, p. 22; 5/8/61, p. 25.*

SPACE VIEWPOINTS: CHALLENGE TO GLASSMAKERS, *by Arthur F. Shoemaker, 1/23/61, p. 40.*

APOLLO. SPACECRAFT PLANS ARE STILL CLOUDY; BOTH APOLLO AND DYNA-SOAR ARE PUSHED, BUT DECISION ON SCIENTIFIC VS. MILITARY EMPHASIS IS YET TO COME—AEROSPACE PLANE IS FACTOR, *5/29/61, p. 42.*

ASP. SPACECRAFT PLANS ARE STILL CLOUDY; BOTH APOLLO AND DYNA-SOAR ARE PUSHED, BUT DECISION ON SCIENTIFIC VS. MILITARY EMPHASIS IS YET TO COME—AEROSPACE PLANE IS FACTOR, *5/29/61, p. 42.*

DYNA-SOAR. DYNA-SOAR TO GET SOLID THIRD STAGE, *3/6/61, p. 12.*

MARINER. MARINER CARRIES PLANET FLY—BY HOPES, *by William Beller and Richard van Osten, 1/2/61, p. 14.*

MARINER. PORTRAIT OF MARINER AT WORK, *6/5/61, p. 45.*

MERCURY PROJECT. AUTOMATIC ABORT FOR MERCURY-ATLAS, *4/3/61, p. 26.*

MERCURY PROJECT. CHIMP TO GO IN NEXT FLIGHT TEST OF MERCURY, *by Jay Holmes, 1/2/61. p. 20.*

MERCURY PROJECT. MAN-IN-SPACE PASSES 'MILESTONE,' *2/27/61, p. 80.*

MERCURY PROJECT. MANNED SHOT AWAITS EXTRA FIRING OF REDSTONE, *3/20/61, p. 15.*

MERCURY PROJECT. MANNED SHOT COULD COME SOON, *by Hal Gettings, 2/6/61, p. 12.*

MERCURY PROJECT. MATERIALS MET TEST ALL THE WAY—AS EXPECTED, *5/15/61, p. 21.*

MERCURY PROJECT. MERCURY MEN BALK AT SWITCH TO TITAN, *2/16/61, p. 13.*

MERCURY PROJECT. NAVY, AF TEAMS SET FOR RECOVERY OF ASTRONAUT, *by Jay Holmes, 2/6/61, p. 36.*

MERCURY PROJECT. REDSTONE WINS OKAY FOR MERCURY, *4/3/61, p. 42.*

MERCURY PROJECT. SEVENTH LITTLE JOE SHOT SEEN; KEY TO MAN-IN-SPACE LAUNCH TIMING IS TEST AT CAPE OF IMPROVED MERCURY REDSTONE, *by Jay Holmes, 3/27/61, p. 37.*

ORBITING ASTRONOMICAL OBSERVATORY. IBM TURNS OUT RECORD STORAGE UNIT FOR OAO, *by Charles D. LaFond, 6/12/61, p. 26.*

P-14. MAJOR NEW RADIATION PROBE READIED FIRST DETAILS OF NASA'S P-14 PAYLOAD DESIGNED TO MAP MAGNETIC FIELDS IN CISLUNAR SPACE WITH NEW RUBIDIUM-VAPOR MAGNETOMETER, *by Charles D. LaFond and Jay Holmes, 1/16/61, p. 15.*

RANGER. HOW RANGER PAYLOAD IS STERILIZED, *by Heather M. David, 3/20/61, p. 27.*

SPUTNIK V. SPUTNIK V SHOWS SOVIETS' KNOW-HOW, *1/23/61, p. 22.*

SPUTNIK VII. SOVIETS SET NEW WEIGHT-LIFT RECORD, *2/13/61, p. 15.*

SURVEYOR. HUGHES TO BUILD NASA'S SURVEYOR SPACECRAFT, *1/30/61, p. 65.*

SURVEYOR. SURVEYOR TO COLLECT WIDE RANGE OF DATA, *by Frank G. McGuire, 3/6/61, p. 33.*

SURVEYOR. WEIGHT OF SURVEYOR PAYLOAD TO BE DOUBLED, *2/20/61, p. 40.*

VOSTOK. DID SOVIETS GAIN MILITARY STEP WITH WINGED SPACECRAFT? *by James Baar, 4/17/61, p. 14.*

VOSTOK. SOVIET MANNED SPACECRAFT IS WINGED, *5/29/61, p. 22.*

X-15. ACTUAL X-15 ALTITUDE: 32 MILES PLUS, *4/10/61, p. 19.*

SPECTROMETER. IR SPECTROMETER HAS STRIKING SENSITIVITY, *by Charles D. LaFond, 5/22/61, p. 30.*

STANDARDIZATION. STANDARDIZATION 'ENGINEERING' IS AN URGENTLY NEEDED DEVELOPMENT, *by Edward W. MacLaren, Jr., 3/27/61, p. 28.*

STANDARDIZATION IDEAL; LETTER TO THE EDITOR, *by Richard H. Pender, 6/12/61, p. 6.*

TRANSDUCER FIELD DEMANDS STANDARDS, *by Harry N. Norton, 5/22/61, p. 34.*

TELEMETERING GROUP SHAPES COMMITTEE ON STANDARDS, *2/6/61, p. 28.*

STRAIN GAGES. DYNA-SOAR MISGAGED; LETTER TO THE EDITOR SIGNED R. WILLIAM JURY, *3/13/61, p. 48.*

SPECIAL GAGES WILL RECORD STRAIN ON DYNA-SOAR, *2/6/61, p. 30.*

SUN. NASA FINDS SOLAR PROBE IS FEASIBLE, *by John F. Judge, 5/8/61, p. 35.*

SWEDEN. SWEDES DEVELOP VERSATILE AIR ROCKETS, *by Bernard Poirier, 1/9/61, p. 36.*

SWITZERLAND. ADAPTABLE SWISS AIRCRAFT ROCKETS, *by Bernard Poirier, 1/16/61, p. 30.*

T

TAPE RECORDERS. NEW BREED OF RECORDERS FOR FUTURE SPACE USE, *by Charles D. LaFond, 2/13/61, p. 24.*

TEFLON. TFE IS UNPERTURBED BY RADIATION, *1/2/61, p. 36.*

TELEMETRY. GE'S 'SYNCHROLINK' SWELLS TELEMETRY RANGE, *3/13/61, p. 30.*

TELEMETRY CAN BE OVER-STANDARDIZED, *5/29/61, p. 26.*

TELEVISION. MICROFILM TV MAY CUT DUPLICATION, *by Charles D. LaFond, 6/5/61, p. 34.*

TEST FACILITIES. ARMY READIES HUGE TEST BUILDING [REDSTONE ARSENAL, HUNTSVILLE, ALA.], *1/16/61, p. 39.*

AUTONETICS' MINUTEMAN TEST AREA HIGHLY STABLE, *2/13/61, p. 39.*

CAPE TEST SCHEDULING IS TRIBUTE TO COOPERATION, *2/20/61, p. 32.*

DOUGLAS GEARS UP FOR SATURN S-IV TEST PROGRAM, *by Frank G. McGuire, 6/5/61, p. 40.*

MODELS AIDED TITAN II SILO SHOT, *by John W. Herrick, 6/19/61, p. 27.*

PACIFIC MISSILE RANGE FACILITIES; ACOUSTIC CHAMBER AND CENTRIFUGE ARE ADDED, *2/6/61, p. 31.*

PREPARING FOR ALL-OUT F-1 TESTS; LAST OF THREE BIG STANDS NEARLY FINISHED; COSTS CUT BY WATER RECOVERY, *by Richard van Osten, 5/8/61, p. 42.*

'PRIVATE OCEAN' FOR POLARIS, *1/9/61, p. 16.*

RCA BUILDING ADVANCED VEHICLE TESTING CENTER, *3/13/61, p. 24.*

SPACE SIMULATOR CENTER PLANNED, *1/23/61, p. 43.*

'THE SUN NEVER SETS' ON ZEUS TESTING FACILITIES, *by John F. Judge, 1/30/61, p. 44.*

TEST PLANT HAS VAST POWER, *5/1/61, p. 41.*

THERMOELECTRIC MATERIALS. THERMOELECTRIC SULFIDES PRODUCED BY WESTINGHOUSE, *3/13/61, p. 41.*

TITANIUM. TITANIUM TO SLASH WEIGHT OF CASES IN MINUTEMEN 2ND STAGE, *2/20/61, p. 22.*

TRANSDUCERS. CLEVITE'S RUGGED 'OYSTER' GIVES CONSISTENT PERFORMANCE, *3/13/61, p. 29.*

TRANSDUCER FIELD DEMANDS STANDARDS, *by Harry N. Norton, 5/22/61, p. 34.*

TUBING. MTC SOLVES SILICON TUBING PROBLEM, *by John F. Judge, 1/23/61, p. 32.*

SUPERIOR TUBING WITHSTANDS WIND TUNNEL PRESSURES, *1/23/61, p. 35.*

TUNGSTEN. TAPCO EXPLORES TUNGSTEN FABRICATION, *by John F. Judge, 3/13/61, p. 36.*

U

UNDERWATER MISSILE FACILITIES. PRIVATE OCEAN FOR POLARIS, *1/9/61, p. 16.*

UNION OF SOVIET SOCIALIST REPUBLICS. DID SOVIETS GAIN GIANT MILITARY STEP WITH WINGED SPACECRAFT? *by James Baar, 4/17/61, p. 14.*

KHRUSHCHEV SEES VICTORY NEARING, *1/23/61, p. 15.*

NEW GAP: U.S., USSR ASTRONOMICAL UNITS, *5/29/61, p. 23.*

SHOOTING VENUS; ORBITAL DATA SHOWS REDS HAD TO USE A BACKUP VEHICLE, *2/20/61, p. 16.*

SOVIET AFFAIRS, *by Dr. Albert Parry, 3/20/61, p. 40; 3/27/61, p. 41; 5/8/61, p. 46; 5/29/61, p. 110.*

SOVIET AIM APPEARS TO BE MAN ON MOON, *4/17/61, p. 16.*

SOVIET MANNED SPACECRAFT IS WINGED . . . FRESH EVIDENCE, *5/29/61, p. 22.*

THE SOVIET PATTERN! *4/17/61, p. 39.*

SOVIETS' NEW BUDGET HEAVY WITH ARMS SPENDING, *by Bernard Poirier, 1/23/61, p. 14.*

SOVIETS REPORTED WORKING ON HYBRID METAL PROCESS, *3/20/61, p. 34.*

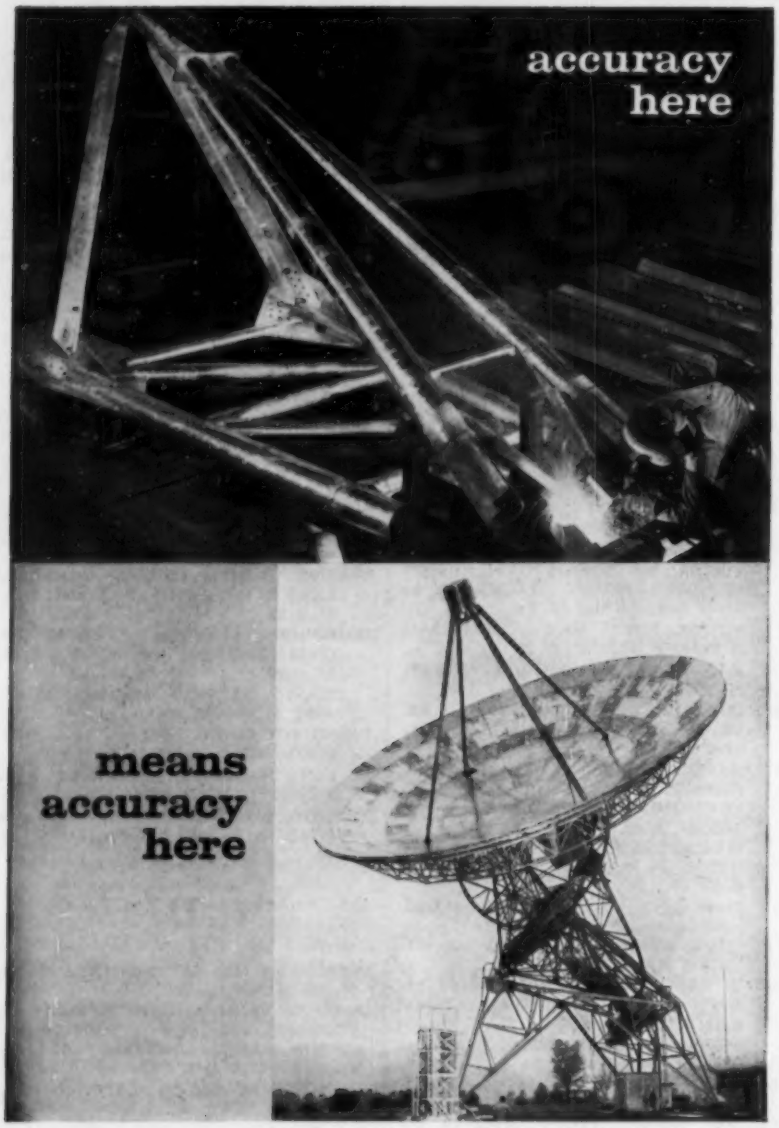
SOVIETS SET NEW WEIGHTLIFT RECORD. RE-ENTRY TROUBLE? *2/13/61, p. 15.*

SPUTNIK V SHOWS SOVIETS' KNOW-HOW, *1/23/61, p. 22.*

A TEMPEST IN A SAMOVAR; EDITORIAL *by William J. Coughlin, 2/13/61, p. 50.*

USSR GEARED TO PRESS SPACE LEAD, *4/24/61, p. 34.*

WILL USSR LEAD IN APPLIED MATH? *by William Beller, 1/16/61, p. 20.*



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UNITED STATES. BIG SPACE SPENDING INCREASE STUDIED, *5/15/61, p. 12.*
BOLD SPACE STEPS DEFERRED; KENNEDY STRESSES STEP-UP OF POLARIS, *by William E. Howard, 4/3/61, p. 13.*
BUDGET '62: MORE? $10 BILLION ASKED FOR MISSILE/SPACE, *by James Baar, 1/23/61, p. 11.*
DRIVE TO BETTER U.S. SPACE 'IMAGE'; WIESNER COMMITTEE REPORT FORETELLS EFFORT TO RESTORE PRESTIGE; HIGHLY PLACED OFFICIAL STRESSES URGENCY, *by Jay Holmes, 1/23/61, p. 16.*
KENNEDY CALLS FOR DEFENSE BEEF-UP, *by James Baar, 2/6/61, p. 16.*
KENNEDY FACES DECISION ON MOON RACE, *by James Baar, 5/1/61, p. 12.*
LATEST REPORTS SAY MISSILE GAP CONTINUES, *by James Baar, 2/13/61, p. 14.*
MILITARY DOGMA FADES SLOWLY, TOO; EDITORIAL *by Clarke Newlon, 1/9/61, p. 50.*
MISSILE/SPACE POLICY CHANGES BEGIN, *by James Baar, 1/2/61, p. 12.*
MORSE ATTACKS OUR 'SPLINTERED' R&D, *6/12/61, p. 18.*
NEW BUDGET REVISION COULD LEAD TO MILITARY MAN-IN-SPACE, *by James Baar, 6/5/61, p. 12.*
SHOOTING VENUS. MILITARY SPACE THREAT GROWS, *by James Baar, 2/20/61, p. 13.*
SPACE EFFORT HURT BY SLOW DECISIONS, *by Jay Holmes, 5/1/61, p. 16.*
SPACE HAS SMALL MILITARY VALUE—NOW, *by Reed Bundy, 5/29/61, p. 111.*
U.S. SEEKS TO SET FIRM SPACE POLICY OBJECTIVES, *3/27/61, p. 15.*
U.S. STUDIES WAYS TO GAIN IN RACE TO MOON, *4/24/61, p. 16.*
U.S. URGED TO EXPLOIT NUCLEAR LEAD, *by John F. Judge, 5/22/61, p. 27.*
WILL TIME RUN OUT FOR KENNEDY BUILD-UP OF U.S. ICBM'S *by James Baar, 6/19/61, p. 12.*
See also names of individual agencies, such as Air Force, etc.
UNITED SYSTEMS, INC. JOINT CONTRACTING COMPANY FORMED, *1/23/61, p. 36.*

V

VENUS. MARINER CARRIES PLANET FLY—BY HOPES; FIRST DETAILS GUIDANCE PLANNED FOR SHOT PAST VENUS, *by William Beller and Richard van Osten, 1/2/61, p. 14.*
NEW GAP: U.S., USSR ASTRONOMICAL UNITS; VENUS MEASUREMENTS, *5/29/61, p. 23.*
SHOOTING VENUS; MAN MAY GET FIRST KNOWLEDGE OF PLANET, *2/14/61, p. 14.*

W

WESTERN GEAR CORP. HOW COMPONENT MAKERS MET DEMANDS; CASE HISTORIES OF AIRESEARCH'S DEVELOPMENT OF APU AND WESTERN GEAR'S WORK ON SYSTEM'S RADAR ANTENNA COMPONENTS, *by Richard van Osten, 1/30/61, p. 46.*
WIRE AND CABLE. ARMY COULD CUT CABLE, CONNECTOR INVENTORY BY BETTER THAN HALF, *3/27/61, p. 23.*
THE HAZARDS OF INCOMPATIBLE PLASTICIZERS, *by John F. Judge, 3/27/61, p. 24.*
A STUDY IN NEAR-CHAOS; WIRE/CABLE PROBLEMS CRY FOR SOLUTION, *by Hal Gettings, 3/27/61, p. 20.*
WIRE AND CABLE REPORT; LETTERS TO THE EDITOR, *5/1/61, p. 7.*

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$126,000,000 — **North American Aviation's Autonetics Division,** for continuing work on *Minuteman* guidance and control subsystems.

$32,310,763—**Hallicrafters Co.,** Chicago, for electronic countermeasures equipment.

$30,634,989—**Westinghouse Electric Corp.,** Pittsburgh, for 14 high-powered, long-range search radars.

$11,682,345—**Douglas Aircraft Co.,** Santa Monica, Calif., for support of the MB-1 *Genie* air-to-air rocket.

$9,000,000—**McDonnell Aircraft Corp.,** St. Louis, for research and development to obtain data on re-entry vehicles.

$5,717,936—**Sperry Gyroscope Co.,** Great Neck, N.Y., for maintenance materiel and parts in support of 4 long-rang search radars.

$5,301,957—**General Electric Co.,** New York City, for 9 high-powered, frequency diversity radars.

$3,469,366—**Minneapolis-Honeywell,** Minneapolis, for development of the primary guidance system for the *Dyna-Soar* test vehicle.

$3,002,922—**RCA Electronic Products Div.,** Camden, N. J., for development work on communications and data link subsystem for the *Dyna-Soar.*

$2,700,000—**Lear, Inc., Astronics Div.,** Santa Monica, Calif., for production of components for flight control subsystem for *Q-C2* drones.

$1,500,000—**Bendix Corp.'s Radio Div.,** Baltimore, for components of radar sets.

ARMY

$8,540,057—**Douglas Aircraft Co.,** Charlotte, N.C., and Torrance, Calif., for production of components for improved *Honest John* rocket.

$5,824,187—**Radio Corp. of America's Defense Electronic Div.,** Moorestown, N.J., for installation of instrumentation tracking radar on Roi Namur in connection with TRADEX Program (Target Resolution & Discrimination Experiment).

$2,143,196—**Raytheon Co.,** Andover, Mass., for production of field maintenance test equipment for the *Hawk* missile system.

NAVY

$1,500,000—**Goodyear Aircraft Corp.,** Akron, Ohio, for depth charge units for the *ASROC* system.

$500,000—**Bay State Electronics Corp.,** Southbridge, Mass., for several hundred VHF-UHF electronic sweep signal generators.

$250,000—**Monitor Systems, Inc.,** Ft. Washington, Pa., from Naval Research Laboratory, for high-speed digital data recording systems.

NASA

$440,140—**Arthur D. Little, Inc.,** Cambridge, Mass., for a study of the blast effect of *Saturn* in the event of failure at launch.

$300,000—**Cubic Corp.,** San Diego, Calif., for updating the space-probe tracking network at Wallops Island, Va.

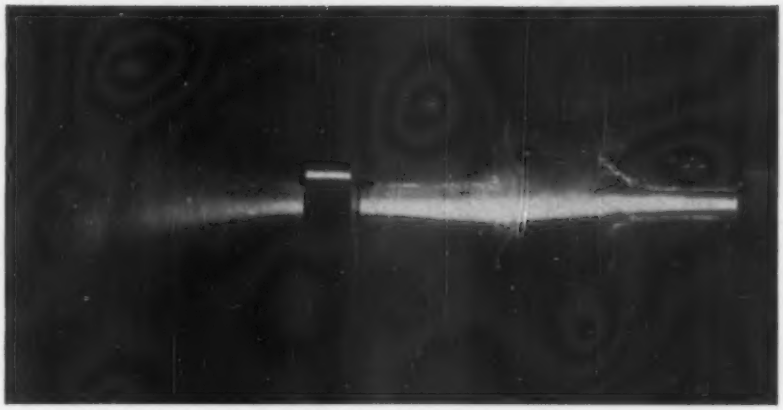
$294,800—**Progressive Welder & Machine Co.,** Pontiac, Mich., for main cluster assembly fixture for *Saturn* and design and fabrication services in connection with providing various *Saturn* tools and fixtures.

$150,000—**G. T. Schjeldahl Co.,** Northfield, Mass., from Goddard SFC, for materials development of plastic spheres for use in a passive communications satellite program.

North American Aviation's Space and Information Systems Division, Downey, Calif., from Goddard SFC, for study of the effects of outer space shrapnel on space vehicles.

PHYSICISTS

for advanced studies of high-performance electrical propulsion systems...



Great interest has been aroused by our unusual oscillating-electron ion engine which produces a high-velocity, electrically-neutral plasma beam. Since this electrically-neutral stream eliminates the space-charge effect, there is no theoretical limit to the thrust capability of the device. ● Past successes and current progress with this device, (and in other areas of plasma research) now require a material expansion in this entire effort. As a result, a number of very attractive Senior Positions are being created for electrical propulsion specialists — particularly physicists with advanced degrees and experience. ● These positions should have particular appeal to those interested in studies of high-energy plasma sources, diagnostic techniques and other basic investigations that will lead to practical space propulsion devices. Included are both theoretical and experimental investigations of factors that determine plasma potentials, ionization and power efficiencies. ● This program is of the long-range sustained type with both corporate and government sponsorship. Superior facilities and assistance are available for numerical computation and experimental work. Publication of papers is encouraged as is close contact with related university research. ● Salary levels, benefits and the semi-academic approach will appeal to experienced men with demonstrated abilities.

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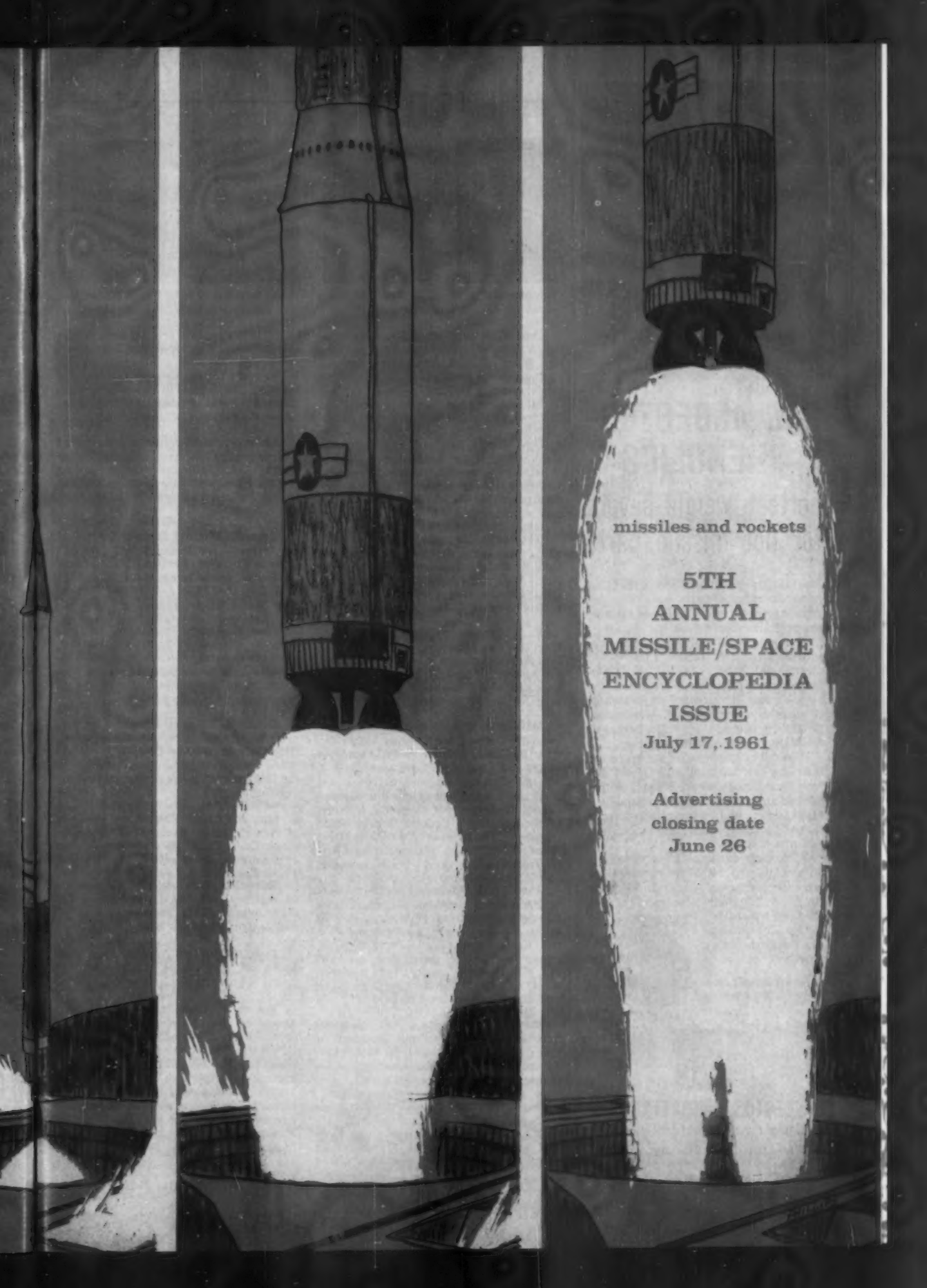
With a total distribution of more than 40,000, M/R's July 17 Missile/Space Encyclopedia issue will thus reach virtually all of the people who direct the activities of the missile/space industry, with the most complete coverage-in-depth of key buying and specifying influences.

*Subject to audit.



missiles and rockets

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July 17, 1961

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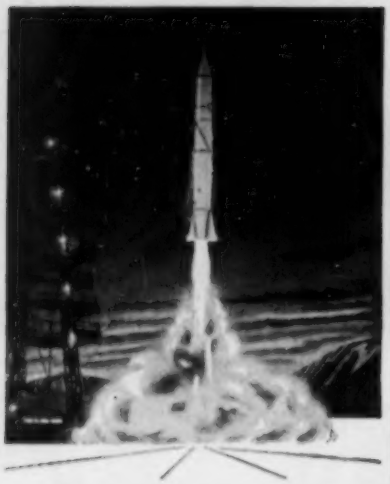

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names in the news

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Dale V. Ness: Named director, Washington office of The Mitre Corp., succeeding **Bryan F. LaPlante,** named special assistant to the president at the company's headquarters in Bedford, Mass.

Mitre Corp, has formed a new Field Test and Evaluation Department at Montgomery, Ala., and Fort Walton Beach, Fla., to handle field test and evaluation for SAGE and for design and evaluation of similar advanced electronic systems. **Lawrence L. Holmes** will head the new department, with **Earle K. Gates** as associate department head.

Thomas A. Brendle: Appointed manager of electronic development, American Optical Co.'s Instrument Div., Buffalo, N.Y. Prior to joining AO's Instrument Div., Brendle was product manager of nuclear systems, Curtiss-Wright Corp.

E. J. Lancaster: Chief, quality assurance, Ballistic Systems Division, AFSC, Los Angeles, elected a vice president of the American Society for Quality Control. Lancaster also is chairman of the Los Angeles Section of the Society.

William S. Blakeslee: Appointed group executive-Defense for Chrysler Corp., Detroit. Blakeslee, formerly general manager of Defense Operations Div., succeeds **I. J. Minett,** promoted to group executive and chief operating officer of the International Group. Blakeslee will direct the activities of the company's Defense Group, which includes the Defense Operations Div., Missile Div., and Advanced Projects Organization.

Fred M. Heddinger: Former assistant to the general manager, named director of newly-created semiconductor molecular electronics department, Westinghouse Electric Corp., Youngwood, Pa. Other appointments in the department are: **Dr. H. W. Henkels,** engineering manager; **K. G. Cooley,** manufacturing manager; and **Ozzie Jaeger,** sales manager.

Roy J. Benecchi: Appointed vice president and assistant to the president of Lear, Incorporated, Santa Monica, Calif. Benecchi has been with Lear in various management posts since 1941.

Fred Hermann: Special projects engineer at Tenney Engineering, Inc., appointed manager of new West Coast Division based at the Harvick Manufacturing Corp., South Gate, Calif., recently acquired by Tenney. Hermann also has been named a vice president of Harvick.

Manuel E. Haskins, Jr.: Appointed manager, Management Science, in the Electronic Data Processing Division of Radio Corporation of America.

Arthur P. Stern: Appointed director of engineering, Electronics Division, The Martin Co., Baltimore. Before joining Martin, Stern was manager of the Electronic Applications Laboratory of the General Electric Co.

Hugh E. Webber: Named director of the Technical and Research Staff, Martin's Orlando Division. Webber replaces **James G. Houser,** named program manager of the MISSILE MASTER and BIRDiE air defense coordination systems.

Jesse L. Jones: Transferred from El Segundo division to Santa Monica division of Douglas Aircraft Co., as vice-president-general manager. **James W. Ross** promoted to general manager of the El Segundo division, effective August 1.

Donald L. Johnson: Promoted to manager, Manufacturing Section, General Electric's Defense Systems Dept. With GE 15 years, Johnson previously was manager of the Department's Support and Implementation Section.

Starr W. Cahill: Elected vice president of manufacturing, Hycon Mfg. Co., Monrovia, Calif. Cahill formerly was director of engineering operations.

Robert L. Dickson: Elected president of Walter Kidde & Co., Inc., Bellesville, N. J. **John F. Kidde,** president since 1943, will become chairman of the board.

Frank L. Roberts: Appointed vice president and assistant to the president of Sperry Gyroscope Co., Great Neck, N.Y.

Warren P. Turner and **Hans Hansen:** Appointed executive assistant to the president and chief engineer, respectively, of KPT Mfg. Co., Roseland, N.J. Turner has been products manager of solid propellants and military explosives, Energy Div., Olin Mathieson Chemical Corp., and special assistant to the vice president and technical director of the High Energy Fuels Div. Hansen formerly was chief engineer of the Engineering Products Division, McKiernan Terry Corp.

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JUNE

Institute of Radio Engineers, 5th Annual Convention on Military Electronics, Shoreham Hotel, Washington, D.C., June 26-28.

British Interplanetary Society, European Symposium on Space Technology, Federation of British Industries, London, June 26-28.

Aerospace Transportation Committee, AIEE, Concepts and Design in Aerospace Electricity, Benjamin Franklin Hotel, Philadelphia, June 26-30.

Rocket Testing in Simulated Space and High Altitude Environments (secret) sponsored by ARO, Inc., Aerospace Corp., USAF, Arnold Center, Tullahoma, Tenn., June 28-29.

Joint Automatic Control Conference, sponsored by AIChE, ISA, ASME, IRE and AIEE, University of Colorado, Boulder, June 28-30.

Institute of Navigation, Annual Meeting, Williamsburg Inn, Williamsburg, Va., June 28-July 1.

National Bureau of Standards, One-day Meeting on High-Precision Connectors. Boulder Laboratories, Boulder, Colo., June 29.

JULY

Western Plant Maintenance and Engineering Show, Pan Pacific Auditorium, Los Angeles, July 18-20.

AFOSR, Differential Equations in Nonlinear mechanics, co-sponsored with Martin's RIAS, Air Force Academy, Colorado Springs, July 31-Aug. 4.

Physics of the Solar System and Re-entry Dynamics, National Science Foundation, NASA, Virginia Polytechnic Institute, Blacksburg, Va., July 31-Aug. 11.

AUGUST

Space Age Astronomy, sponsored by Douglas Aircraft Co., CalTech, Pasadena, Calif., Aug. 7-9.

American Rocket Society, Stanford University, Guidance and Control Conference (some sessions classified), Stanford University, Palo Alto, Calif., Aug. 7-9.

Sixth Annual Technical Symposium, Society of Photographic Instrumentation Engineers, Ambassador Hotel, Los Angeles, Aug. 7-11.

International Astronomical Union, Eleventh General Assembly, Pasadena, Calif., Aug. 15-24.

International Conference on Hypersonics, American Rocket Society, Compton Lecture Hall, Massachusetts Institute of Technology, Cambridge, Aug. 16-18.

Welded Electronic Packaging Association, Symposium, Lockheed Missiles and Space Div.'s Palo Alto research facility, Palo Alto, Calif., Aug. 21.

10th Pacific Science Congress, National Academy of Sciences, University of Hawaii, Honolulu, Aug. 21-Sept. 8.

Advertisers' Index

Aerospace Corp. 21
Agency—Gaynor & Ducas, Inc.

American Machine & Foundry Co.—Government Products Group 33
Agency—Cunningham & Walsh, Inc.

Blaw-Knox Co., Blaw-Knox Equipment Div. 50
Agency—Ketchum, MacLeod & Grove, Inc.

Callery Chemical Co. 41
Agency—Ketchum, MacLeod & Grove, Inc.

Cannon Electric Co. 8
Agency—Anderson-McConnell Adv. Agency, Inc.

Defense Systems Div.—General Motors Corp. 18
Agency—D. P. Brother & Co.

Donner Scientific Co., a Sub. of Systron Donner Corp. 58
Agency—Banfield Assoc., Inc.

Dorsett Electronics Labs., Inc. ... 42
Agency—Galloway-Wallace Adv. Agency, Inc.

Dunn Engineering Corp. 22
Agency—S. Gunnar Myrbeck & Co., Inc.

Elgeet Optical Co., Inc. 10
Agency—The Wexton Co., Inc.

Federal Electric Corp. 6, 7
Agency—Richardson, Thomas & Bushman, Inc.

Government Products Group, American Machine & Foundry Co. 33
Agency—Cunningham & Walsh, Inc.

Grand Central Rocket Co. 17
Agency—Foote, Cone & Belding

Lockheed Aircraft Corp., Missiles & Space Div. 39, 40
Agency—Hal Stebbins, Inc.

Microdot, Inc. 35
Agency—Carson/Roberts/Inc.

Monsanto Chemical Co., Corporate Div. 2, 3, 4
Agency—Gardner Adv. Co.

Poly-Scientific Corp. 11
Agency—Houck & Co., Inc.

RCA Service Co., a Div. of Radio Corp. of America 43
Agency—Kenyon & Eckhardt

Reinforced Plastics, Dept. of Raybestos Manhattan, Inc. ... 54
Agency—Gray & Rogers, Adv.

Research Labs.—United Aircraft Corp. 51
Agency—B. E. Burrell & Assoc.

System Development Corp. 57
Agency—Fuller & Smith & Ross, Inc.

editorial . . .

A New Emphasis on Quality

DEFENSE SECRETARY McNAMARA and his staff are taking a close look at some of the procurement practices which have been wasting a sizable portion of this nation's defense expenditure. This is not only to be welcomed, but it is a step which many leaders of the missile/space industry have been urging for some time, particularly in the electronics field.

Loose specifications, poor quality control, overemphasis on initial price with a corresponding lack of attention to long-life performance, have concerned responsible firms to an increasing degree of late.

There has been a singular lack of reward for the company turning out a quality product. Cost-cutting in procurement has been carried to the point where subsequent maintenance and spare parts costs have skyrocketed out of all proportion.

This has left the firm which attempts to do a responsible job in a difficult position. It can either reduce the quality of its products or watch the red ink mount as government contracts go to less conscientious competitors.

While it is comforting to think that quality eventually will tell, this is little solace to a firm already forced out of business.

The blame for this situation usually falls on the Defense Department. But a great many other factors are involved. Emphasis in Congress and the press has been on initial cost of equipment, with correspondingly little emphasis on the over-all amortized costs. Highly vocal critics of the "profiteering" defense industry have forced DOD further and further toward cost reimbursement contracts and away from fixed-price contracts, which are less easy to defend against this charge.

Deputy Secretary Roswell Gilpatric pointed out recently that where 87% of Air Force procurement ten years ago was through fixed-price contracts and less than 13% on a cost reimbursement basis, cost reimbursement contracts today account for almost 43% of procurement.

Cost reimbursement contracts of the cost-plus-fixed-fee type, which make up the present majority, weaken the incentive for economy. Emphasis has been on profit-cutting at the expense of cost-cutting.

Defense Secretary McNamara now has come up with what has been described as a new type of incentive contract. This is called the "cost-plus-award-fee" contract which will penalize poor performance, reward good performance. The approach is not entirely novel, as anyone will realize who looks at the military contract for the first Wright Bros. airplane.

But it certainly places the emphasis where it belongs: on over-all performance and quality and reliability of the product, in comparison with the original military specifications. This type of contract will not be easy to administer in the missile/space industry. But it deserves every chance.

THE REASON is evident. It was put well in a recent speech by W. A. MacDonald, chairman of the board of Hazeltine Corp. He estimates that only 25% of the budget allocation in electronic procurement goes into new weapon systems. Annual maintenance cost of electronic weapon systems inventory is placed at 60% of initial cost.

Yet the emphasis in letting contracts, as Mr. MacDonald suggests, has been on equipment which will meet the minimum requirements at the lowest possible price.

"The adverse ratio of maintenance cost to initial cost either on the basis of yearly or useful life costs seems to me to indicate something basically unsound in our procurement philosophies," Mr. MacDonald says. "We . . . have gone far beyond a safe balance in reducing first or instantaneous costs and are paying a terrible price in maintenance costs."

The Hazeltine chairman estimates that a 50% improvement in failure factor could mean an annual saving of $1.7-billion, or one-third the total electronics budget, on maintenance, support equipment and spare parts costs.

One step toward this is the realization that the true cost of a black box is based, not merely on its initial cost, but on its useful life, including maintenance costs. Another is the incentive contract proposed by DOD.

We welcome DOD's approach and hope it will be coupled with a full recognition of quality and reliability as well as initial cost and on-time delivery. This would encourage those missile/space firms which are making the most worthwhile efforts—and serve notice on those which are not to either toe the mark or get out of the industry.

William J. Coughlin

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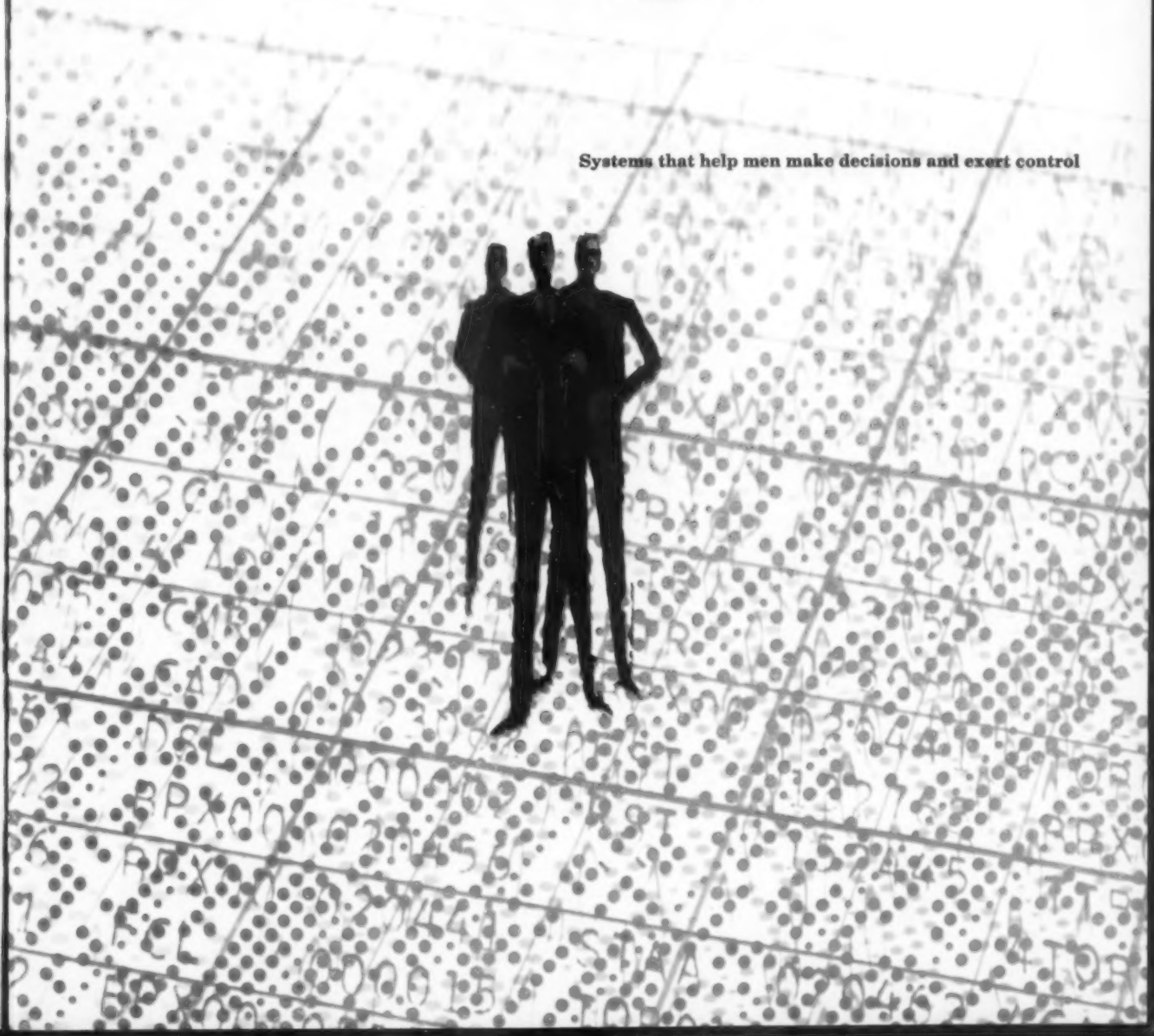
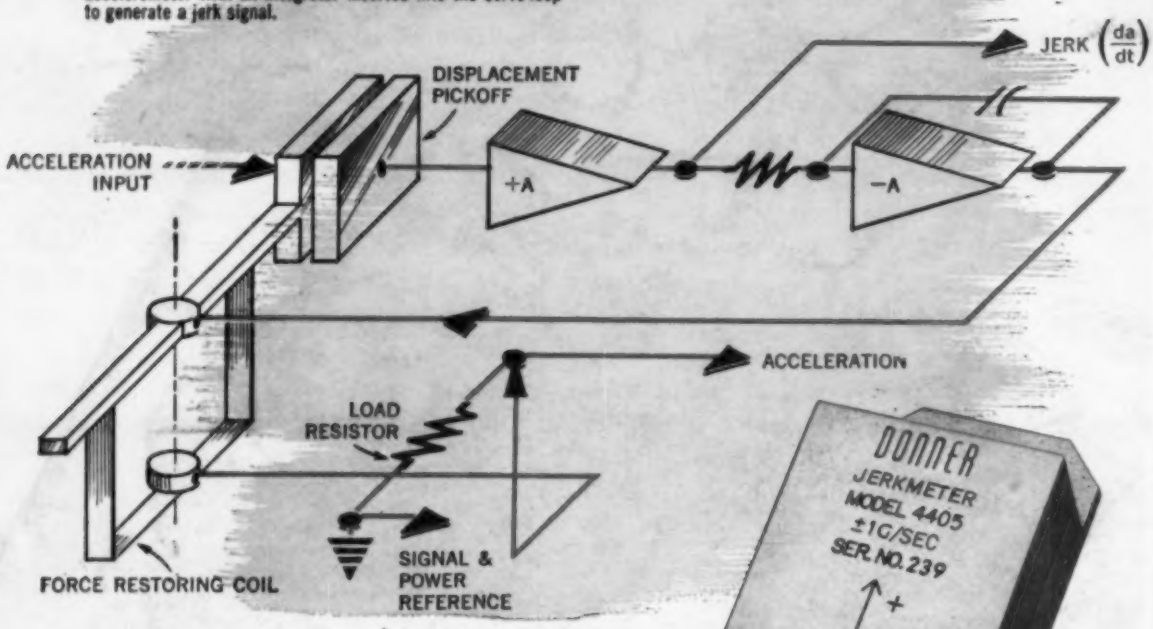


961

Functional diagram of Donner Linear Jerkmeter. This unique instrument operates as a subminiature servo-system of the force-balance type which is responsive to jerk along the sensitivity axis of the linear unit and about the sensitive axis of the angular unit. Basically, the system consists of a transistorized accelerometer with an integrator inserted into the servo-loop to generate a jerk signal.



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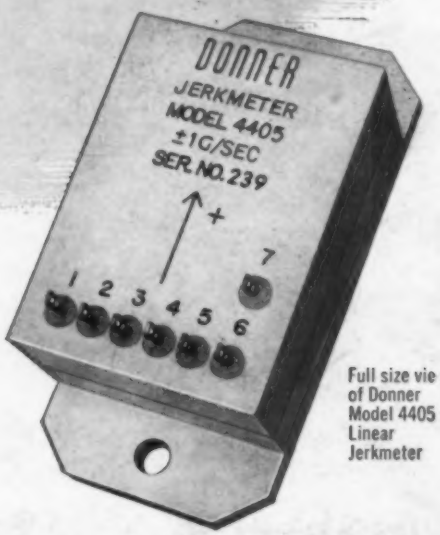

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These new instruments are the only truly accurate device of this type ever made. They are designed to meet the most demanding applications. Both angular and linear jerkmeters provide an output voltage proportional to jerk which in turn can be used to instigate compensatory control forces or other actions. *An acceleration analog output voltage is also available.*

Typically, a jerkmeter installed in a jet aircraft will provide an instantaneous output proportional to the rate of change of g's. This signal can be used to predict impending disaster conditions.

Other applications include use wherever constant acceleration is required. Here, the Donner jerkmeter provides a "velocity-damping" term. The jerkmeter also provides a third order term for stabilizing displacement devices. It can also be used as an inertial indicator of first motion.

KEY SPECIFICATIONS for Model 4405 Linear Jerkmeter

RANGES
Acceleration: ±1 g full range to ±30 g full range
Jerk: ±0.5 g/sec full range to ±20 g/sec full range

OUTPUT FULL SCALE
Accelerometer: ±7.5 v dc
Jerk: ±7.5 v dc

RESOLUTION
0.1% full scale or better

LINEARITY
0.1% full scale or better

HYSTERESIS
Less than 0.1%

POWER
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SIZE
3" long, 1½" wide, 1⅝" high

WEIGHT
7.5 ounces

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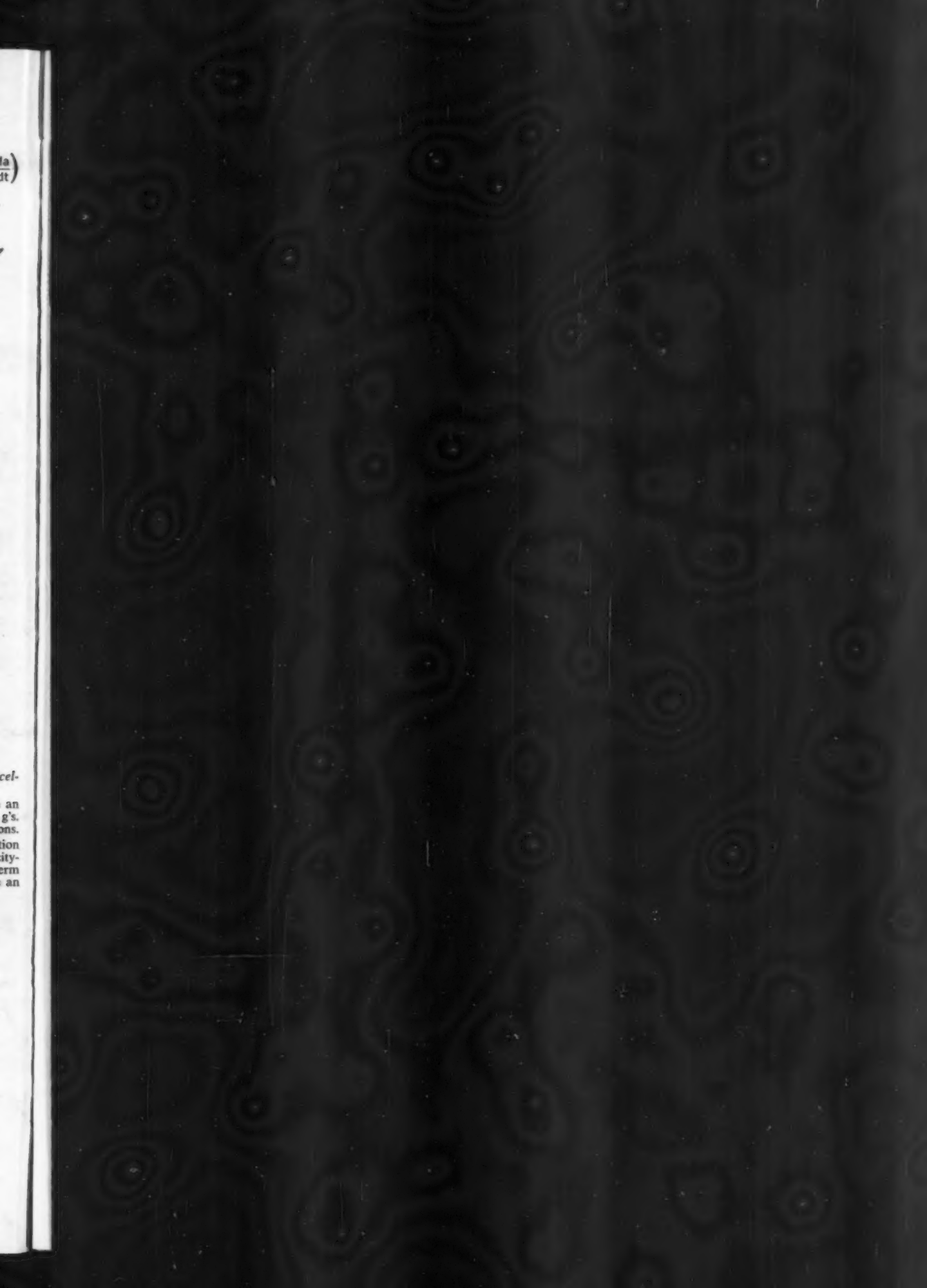
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